№ HE 4471.B8B71 1919

GIVEN BY

M. T. A.

HE 4491
.B8B71
1919

CAMBRIDGE SUBWAY

FACTS AND FIGURES
RELATIVE TO ITS
COST

THE BOARD OF TRUSTEES
OF THE
BOSTON ELEVATED RAILWAY COMPANY

1919

BOSTON PUBLIC LIBRARY
3727

CAMBRIDGE SUBWAY

FACTS AND FIGURES
RELATIVE TO ITS
COST

THE BOARD OF TRUSTEES
OF THE
BOSTON ELEVATED RAILWAY COMPANY

1919

BOSTON PUBLIC LIBRARY

HE 4491
.B8B71
1919

Metropolitan Transit Authority
Dec. 4, 1957

FACTS AND FIGURES

relative to

COST OF CAMBRIDGE SUBWAY.

COST, EXCLUSIVE OF TRACK, LINE AND STATION EQUIPMENT

1. Subway proper; Eliot Square to Cambridge Bridge ...	$7,085,949.98
2. Proportion of cost of Cambridge Bridge	591,747.27
3. Approximate cost of Elevated Connection	412,000.00
Total	$8,089,697.25
4. Eliot Square Terminal	1,007,744.30
	$9,097,441.55

COST, INCLUSIVE OF TRACK, LINE AND STATION EQUIPMENT

1. Cambridge Subway proper	$7,412,828.23
2. and 3, Cambridge Bridge and Elevated Connection ...	1,497,794.00
Total	8,910,623.23
4. Eliot Square Terminal	1,065,794.00
	$9,976,416.23

GENERAL DATA

Authority — Construction — Supervision of Expenditures

AUTHORITY FOR CONSTRUCTION: Chapter 520 Acts of 1906.

TUNNEL PROPER IN CAMBRIDGE: Extends from Eliot Square to Cambridge Bridge; paid for and owned by the Boston Elevated Railway Co.

CAMBRIDGE BRIDGE: A substantial portion of its cost paid for by the Company.

CONNECTION between Cambridge Bridge and Beacon Hill Tunnel; erected and paid for by the Company.

Tunnel under Beacon Hill to Park Street, like Dorchester tunnel owned by the City of Boston and leased to the company (at 4⅞% of its cost as annual rental).

CONSTRUCTION OF THE SUBWAY IN CAMBRIDGE: Done under contract with Hugh Nawn Contracting Co.

WORK COMMENCED: July 12, 1909.

OPENED FOR BUSINESS: March 23, 1912.

CITY OF CAMBRIDGE: Permitted by Statute 1906, Chapter 520, Section 28, to purchase the subway in Cambridge only, on certain terms. A table showing the amount which under that section the City of Cambridge would have to pay as of November 1, 1918 (present time) is printed at the end hereof (page 3).

INTEREST DURING CONSTRUCTION: Sec. 28, Chapter 520, Acts 1906, provides that interest during construction shall be figured *only* at the rate of 3¼% per annum. It is well known that the actual interest cost was at least 2% in excess of that figure and that increase would add $162,874.72 to the figures given.

CERTIFIED COPIES OF ALL BILLS and accounts of cost of construction were, by Sect. 16, of the Act, required to be and were promptly filed with the Auditor of the City of Cambridge.

CITY OF CAMBRIDGE SUPERVISED EXPENDITURES: The City employed an engineer throughout the period of construction to keep tabs on the cost and to protect the City's interests, in order to see that the cost was proper.

TOTAL COST: The total shown by these bills and accounts as of March 22, 1912, was $7,089,300.25. This total with a summary of the items of which it was composed was certified to under oath by the City Auditor and the Consulting Engineer of the City of Cambridge as well as the General Auditor of the Boston Elevated Railway Company.

The slight variations between the figures given as of March 22, 1912, and November 1, 1918, are due to various debits and credits between these dates.

WHAT CAMBRIDGE WOULD PAY

Amount which the City of Cambridge would pay the Boston Elevated Railway Company in case of purchase of the Cambridge-Main St. Subway, as provided in Section 28, Chapter 520, Acts of 1906, to November 1, 1918.

7% simple interest on $6,075,604.47, which was paid in on the issue of 55,000 shares of stock, from Mar. 23, 1912 to Nov. 1, 1918—6 yrs. 7 mons., 8 days.....	$2,809,292.00	
Less dividends paid during period (as per detail shown on separate statement) ...	1,632,671.23	$1,176,620.77
7% simple interest on $1,638,000 which was paid in on the issue of 15,600 shares of stock, from Jan. 18, 1913 to Nov. 1, 1918—5 yrs., 9 mos., 13 days.....	$659,175.74	
Less dividends paid during period (as per detail shown on separate statement)....	369,684.93	289,490.81
Total.....		$1,466,111.58
Allowing credit from the date that the $300,776.24 excess capital was authorized to be used for other purposes.		
7% simple interest on $300,776.24 from Dec. 20, 1917, to Nov. 1, 1918, 315 days.....	$18,170.18	
Less proportion of dividends at the rate rate of 5% per year on $300,776.24 from July 1 to Oct. 31, 1918, 123 days.....	5,067.87	13,102.31
Net Interest Less Dividends		$1,453,009.27
Cost of the construction of the Cambridge Subway including its appurtenances, except rolling stock (as shown on separate Statement).....		7,412,828.23
TOTAL.....		$8,865,837.50
Amount saved if House Bill 721 is enacted.....		$1,453,009.27

GRAND JURY FINDINGS ON CAMBRIDGE SUBWAY CONTRACT.

Because of various intimations of the sort made before the present Legislative Committee, the Middlesex County Grand Jury in June, 1914, investigated the contract for the building of the Cambridge Subway,

"with reference to general charges of violation of the criminal law in regard to the same and particularly in reference to the following charges:

"1. That persons interested in the Boston Elevated Railway Company, or influential in its business, made a profit out of the contract for the construction of the Cambridge Main-Street Subway, either through ownership of the stock of the Hugh Nawn Construction Company, the contractor for the Main-Street Subway, or in some other manner.

"This charge the Jury finds after full examination of all persons connected with the Hugh Nawn Construction Company and the Elevated Company to be unfounded, and there is no stock in the Hugh Nawn Construction Company owned by anybody except H. P. Nawn, and its profits were not divided with any person or persons."

The charge was also made:—

"2. That in some way there was graft in connection with the contract for the Subway construction so that eventually the City of Cambridge might be obliged to pay an excessive amount in purchasing the same,"

and

"3. That because of the form of the contract which provided for the construction of the Subway at cost plus 10 per cent., with a premium for the performance of the work under certain conditions, and a forfeiture under certain conditions, the work cost more than it should have cost."

The Grand Jury says:—

"On the evidence of all persons who had any direct connection with any part of this work, both for the Elevated Railway Company and the Hugh Nawn Construction Company and the City of Cambridge, the Cambridge-Main Street Subway work was well and honestly done without any graft in its inception, performance or completion.

"There is no reasonable doubt that the cost of the Subway was not excessive; that the contract was not improper in form, nor unreasonable nor unusual either in its form or its terms.

"It has been established to the satisfaction of the Grand Jury that the premium system adopted and applied in the construction of the Subway was a proper and effectual method of securing the contractor's best efforts, and the amount which the city may be called upon to pay is not in any way excessive but that, on the other hand, on all of the evidence, it is a reasonable price and, as stated, on the evidence of its own experts and officials, is a low price and below the estimates of its own experts of the probable and reasonable cost of the Subway.

"The Grand Jury voted unanimously to make this report in detail because they have every reason to believe from the evidence presented before them that the circulation of the charges and rumors above referred to has been, in many cases, malicious and, in all cases, unwarranted by the facts."

COST TO COMPANY APPROVED BY RAILROAD COMMISSION

The stock of the Boston Elevated Railway Company sold in order to pay for the subway was issued under the supervision and audit of the Railroad Commission as to the "*amount which has been* PROPERLY *expended*" for the purpose. (See Statute 1906, Chapter 463, Part III, Section 103).

On December 18, 1908, the Railroad Commission authorized the issuance of $5,500,000 par value, sold at 110, which produced $6,075,604.74 in cash. (Orders 7199–7200).

On December 6, 1912, the Commission authorized the issuance of stock of the par value of $1,560,000, the proceeds of which were ordered "to be applied exclusively toward the payment of the sum of $1,438,602.27 expended by the petitioner (Boston Elevated Railway Company) prior to August 31, 1912, in excess of the proceeds of stock heretofore authorized to be applied to that purpose on account of the original cost of the Main Street Subway which the Company is authorized to construct by Chapter 520 of the Acts of 1906, and of its appurtenances and equipment, exclusive of rolling stock, and also to the payment of additional expenditure not exceeding $200,000 which may be made for the same purpose after August 31, 1912." (Order 9111).

DETAILED REPORT OF ENGINEER OF BOSTON TRANSIT COMMISSION

The Special Commission appointed to consider the financial condition of the Boston Elevated Railway Company, whose report is printed as Senate Document, No. 344 of 1917, during its investigation requested the Boston Transit Commission to report upon the fair cost of the Cambridge Subway. The detailed report of the Engineer of the Boston Transit Commission, who carefully went over the whole subject is so comprehensive in its study and exposition of the facts that it is printed in full hereafter.

CAMBRIDGE MAIN STREET SUBWAY COSTS AND ESTIMATES

INDEX

Report to Chief Engineer, Boston Transit Comm., pages 8 to 11.
Auditor's Statement, Boston El. Ry. Co., pages 12 to 17, tables A-1 to A-7.
Engineer's Estimate, Boston El. Ry. Co., pages 18 to 19, tables B-1 to B-3.
Additional Information on Costs, pages 20 to 23, tables C-1 to C 6.
General data on Cambridge Subway, from Boston El. Ry. Co., pages 24 to 26, tables D-1 to D-3.
General data on Boston Subways, from Boston El. Ry. Co., pages 27 to 31, tables E-1 to E-6.
Sub-d vision of payments to Contractor, pages 32 to 34, tables F-1 to F-4.
Analysis of Engineer's Estimate, Boston El. Ry. Co., pages 35 to 44, tables G-1 to G-17.
New Estimate on Cambridge Subway, page 45, table G-18.
Contract and bond, Cambridge Subway, pages 46 to 49, tables H-1 to H-10.

January 6, 1917.

Mr. Edmund S. Davis,
Chief Engineer.

Dear Sir:—

As requested by you, I herewith submit the following report on the Cost of the Cambridge Main St. Subway, exclusive of the Terminal Yard, together with an approximate estimate of the cost if built by contract on unit prices, based on similar work at that time.

The Boston Elevated Railway Co. has furnished me with records of Costs from their Auditing Department, and with plans and other data from their Engineering Department, all of which are herewith appended to this report and indexed. In addition, I have had the valuable assistance of Mr. Howard E. Whiting, Assistant Engineer, Boston Elevated Railway Co., who had complete charge of all cost accounts during the entire construction of the Cambridge Subway. Mr. Whiting has rendered every possible service in going through records and estimate books with me and giving fully all information needed as to costs and quantities.

COST

Method of Keeping.

The cost of the Cambridge Subway has been kept by the Boston Elevated Railway Co., in accordance with the provisions of the Act under which it was built, which provides (as will be seen by referring to table A-1) for certain methods of adding interest to the original cost. The costs given below are brought up to November 1, 1916; the items being shown in table A-4 from the Auditor's office. I have obtained more details regarding some items which were not self-explanatory and have rearranged them more in detail in table C-3.

Certain Equipment.

Certain of these items, such as ballast, conduits, etc., would be considered as equipment, and would not enter into work done by the Boston Transit Commission, although the Auditor's Department of the Boston Elevated Railway Co. has considered them as part of the subway construction and have so carried them on their construction ledger. I have separated these items in tables C-4 and C-5 and made an estimated construction cost, omitting these items, basing it on the Boston Elevated Railway Co.'s costs.

This estimated construction cost $6,918,499.43
(See table C-5)

Construction cost as carried by the Auditor's Department $7,073,349.98
(See table A-4, also C-3)

Equipment.

The amount that is considered as equipment by the Auditor's Department and carried as such is shown in table A-2 and equals $326,725.40, thus bringing the total cost of construction and equipment up to $7,400,075.38.

It will be noted that it was necessary to carry the cost of construction and equipment together under the provisions of the Act, which provides in case of the sale of the subway to the City of Cambridge that the city shall reimburse the company for the cost of the subway and "appurtenances and equipment."—(see table A-1).

Interest.

The method by which the interest was computed prior to and after the opening of the subway is seen by referring to table A-1, *in italics*. The interest on both issues of Capital Stock, together with the amounts deducted for dividends, are shown in table A-3, the remaining amounts of $693,577.87 and $164,367.71, or a total of $857,945.58 being added to the cost of construction and equipment as provided in the Act, (see also table C-2).

Total Cost.

The total cost up to November 1, 1916, complete with equipment (exclusive of rolling stock) and with all interest added is $8,258,020.96. —(see table A-3).

Cost of Construction of Subway Proper.

The above costs have included all items such as land, damages, removal of underground structures, changes in tracks, etc., as well as the actual cost of the subway itself. This cost is shown in table A-4, under the item "Construction of Tunnel" and is $5,543,621.78. Of this amount $15,421.06 represents the work done by departments of the Boston Elevated Railway Co., and $5,528,200.72, the amount paid the contractor, which, as will be seen, represents practically the entire cost of the actual subway construction, including also certain before-mentioned items of equipment to the amount of $113,687.00—(see table C-4).

CONTRACT

The contract under which the subway was built was on a cost plus basis, and provided that the contractor supply all labor and materials, machinery, tools and appliances at actual cost plus 10%. It also provided that the contractor should furnish all small tools himself without any compensation. It further contained a bonus and penalty clause amounting to 25 per cent of the difference between the actual cost and the Engineer's Estimate.

ENGINEER'S ESTIMATE

The Engineer's estimate, shown in tables B-1, B-2 and B-3, was made up from actual quantities measured and calculated as the work proceeded, and estimated on unit costs prevailing at that time.

The total amount of this estimate, on which the amount paid the contractor was based, is shown in table C-1.

As this total estimate includes certain items of equipment, I have shown in table C-4 the estimate as it would stand with these items of equipment kept separate.

DETAILS OF ENGINEER'S ESTIMATE.

The unit prices used in the Engineer's Estimate as stated before were based on prices prevailing at that time, and considerable data was collected on costs of work in Boston and elsewhere. This data is contained in the records of the Boston Elevated Railway Co., and I have taken from these records such data and costs as applied, and tabulated them in an analysis of the Engineer's Estimate, as shown in tables G-1 to G-17.

It will be noted that some items in the Engineer's estimate do not contain *quantities*. In each of these cases I have obtained all available data and included it in the above analysis.

NEW ESTIMATES

In making a new estimate of the probable cost of the Cambridge Subway under the methods of subway construction used in Boston it is necessary not only to take into consideration the unit prices bid on work in Boston, but also certain other costs which finally enter into the cost of construction. Certain of these costs are carried in Boston subway work under the head of Engineering and General Expenses, that were included direct in the unit prices on the Cambridge subway Engineer's Estimate, such as maintenance of yard, etc.

There are also other items generally appearing in Boston Subway work, which do not appear in the Cambridge Subway Engineer's Estimate, but which would finally enter into the total cost of construction. These are items for "Extra Work" and "Other Work and Risks Not Appearing in Other Items." From data obtained it has been estimated that all these different costs would amount to approximately 3 per cent. and this figure has been used in the new estimate.

The unit prices used for each separate item in the new estimate were arrived at from the available data obtained in the analysis of the Cambridge Subway Engineer's Estimate, and all differences and conclusions arrived at are noted with each separate item in the analysis.

The new estimate is shown in table G-18, and, as will be noted, includes only items of subway construction that were in the Cambridge Subway Engineer's Estimate, as all other items are given at actual cost.

The other items entering into the total cost of the subway, such as Engineering and General Expenses, Land, Damages, Taxes, Interest, etc., are shown on the Auditor's Statement at actual cost, and are o such a complicated nature that a great deal of research will be necessary if other than an approximate estimate is required.

I have, however, shown in table C-6 an estimate of the cost per linear foot of subway, including land, interest, and in fact all expenses (without equipment, as it is omitted on Boston Subway work) and in the same table have added similar data on Boston Subway work.

Respectfully submitted,

(Signed) E. R. SPRINGER,

Assistant Engineer.

STATEMENT OF CAMBRIDGE, MAIN ST. SUBWAY TO NOVEMBER 1, 1916.

The Cambridge, Main St. Subway was built under the provisions contained in Chapter 520 of the Statutes of 1906.

Section 28 *provides for its purchase by the City of Cambridge as follows*:

At any time after the expiration of twenty years from the opening for use of the Main Street Subway, or at any earlier time by agreement with the company, and upon the payment to it by the city of such an amount as will reimburse the company *the original cost of the Main street subway* and the River street subway, if the latter is then built or begun, and their *appurtenances and equipment, which shall not include rolling stock, together with the cost of all additions or alterations lawfully made thereto or therein, with simple interest at seven per cent per year on the cost paid in by its stockholders, to be computed from the time of such payment by the stockholders (but not prior to the opening for use), to the time of the purchase, in addition to interest at three and one-fourth per cent per year on all sums expended in construction from the time of their expenditure to the time of the opening for use, deducting, however, from such interest any and all dividends declared and paid after such opening for use upon any stock issued therefor*, but without interest on such dividends, and also deducting from the purchase price such other amounts accruing from property acquired for such two subways as are provided for by section nine of this act, the title to such two subways and their appurtenances and equipment as aforesaid and additions thereto, and all rights and interests therein, shall vest exclusively in the city. This right of purchase of the city shall be in addition to the right of the commonwealth under sections six and seven of chapter one hundred and eleven of the Revised Laws, but shall not otherwise affect any rights of the commonwealth. Upon such purchase the city shall have, hold and enjoy in its private or proprietary capacity, as its own property, the subway or subways and their appurtenances and additions so acquired, and all rents, tolls, income and profits derived therefrom, and the same shall never be taken by the commonwealth except upon payment of just compensation therefor; provided, however, that so much of said rents, tolls, income and profits as may be necessary therefor shall be paid into the respective sinking funds for the redemption of any bonds which shall be issued by the city for such purchase and shall be used for the payment of interest thereon. At any time after the expiration of twenty years from the opening for use of the Main street subway, or at an earlier time by agreement with the company, the city may purchase the Cambridge Street subway, if then built or begun, and the Webster avenue subway, if then built or begun, and their appurtenances and equipment as aforesaid, and shall purchase both if either, upon the same terms, conditions and provisions and with the same effect as is hereinbefore provided for and concerning its purchase of the Main street subway.

(A–2)

The cost of the Cambridge, Main St. Subway (exclusive of Rolling Stock) is as follows:

Construction of Subway, June 30, 1916		$7,089,987.36
Cost of Construction	$6,727,825.79	
Interest at 3¼% as provided in Act	362,161.57	
Net credit June 30, 1916, to Nov. 1, 1916		16,637.38
Total Construction of Cambridge Subway, Nov. 1, 1916		$7,073,349.98
(See next page for distribution as per ledger)		
Cost of Construction	$6,711,188.41	
Interest at 3¼% as provided in Act	362,161.57	
Equipment (exclusive of Rolling Stock) Nov. 1, 1916		326,725.40
Cost of Equipment	308,678.54	
Interest	18,046.86	
Total Cost of Construction and Equipment		7,400,075.38

Complete detail of this cost has been furnished the City of Cambridge in accordance with Section 16 of Chapter 520.

The following amounts of stock and bonds were issued to provide the capital for the construction of Cambridge, Main St., Subway.

55,000 shares authorized Dec. 18, 1908		
Issued Jan., 1909, to Feb., 1910, @ 110.45		
Total amount paid in by subscribers	$6,075,604.74	
Par	$5,500,000.00	
Premium	575,604.74	
15,600 shares authorized		
Issued Jan., 1913, - May 21, 1913, @ 105.00		
Total amount paid in by subscribers	1,638,000.00	
Par	1,560,000.00	
Premium	78,000.00	

The following amount of bonds was issued for abutters' damages:

Dated Dec. 2, 1912, issued Nov. 9, 1915		
Proceeds received Nov. 13-23, 1915, on $25,000 @ 92.159	23,039.75	
Par	25,000.00	
Discount	1,960.25	
Total capital issued		$7,736,644.49
Balance unexpended Nov. 1, 1916		$336,569.11

(See statements of Nov. 1, 1918)

The Subway was opened for public use March 23, 1912. (A–3)

Simple interest @ 7% on the cost paid in by the stockholders from the time of such payment (but not prior to the date of opening) to date (Nov. 1, 1916) would be as follows:

Interest from March 23, 1912, to Nov. 1, 1916 — 4 years, 7 months, 8 days on $6,075,604.47	$1,958,577.87
Less dividends declared and paid during that time	1,265,000.00
	$693,577.87

Interest from Jan. 18, 1913, to Nov. 1, 1916 — 3 years, 9 months, 13 days on $1,638,000	429,567.71
(See separate statement for method of figuring this interest)	
Less dividends declared and paid during that time	265,200.00
	$164,367.71

No provision is made in Section 28 for any interest to be figured on proceeds from Bonds.

Under this act the City of Cambridge would be required to pay for the Subway as follows:

Cost of construction including 3¼% interest as provided	$7,400,075.38
Interest on Capital Stock	857,945.58
TOTAL	$8,258,020.96

This does not provide for the purchase for anything but the Subway itself from the beginning of the inclines at Mt. Auburn St. and at Mass. Ave., Cambridge, to the beginning of the incline at Kendall Sq., Cambridge, including the branch of the subway toward the Eliot Sq. Shops as far as the portal.

(See statement of Nov. 1, 1918)

(A–4)

Detail of Construction of Cambridge, Main St. Subway as per special construction ledger to November 1, 1916:

Engineering and General Expense		373,562.58
Right of Way		233,839.62
Former "Real Estate" a/c	$103,801.17	
Land	60,875.00	
Damages	69,163.45	
Other Land Used in Elec. Ry. Operations		1,018.34
Tunnels		6,030,898.73
Construction of Tunnel	$5,543,621.78	
Removal of underground structure	251,183.86	
Temp. Line Changes	37,625.84	
Temp. Track Changes	184,128.40	
Electric Lighting	14,338.85	
Stations		62,743.80
Taxes during Construction		9,125.34
Interest during Construction		362,161.57
TOTAL		$7,073,349.98

(See statements of Nov. 1, 1918)

(A–5)

Dates and amounts of money received for subscription to Capital Stock; 39,294 shares @ $105. 15,600 shares to apply to Cambridge Subway, or 39.7007%.

Date of Payments	Amount	Proportion to Camb. Subway	Total to date	Number of Days	Interest
Jan. 7	$6,435	$2,554.75	$2,554.75	1	$0.49
8	17,475	6.937.71	9,492.46	1	1.82
9	14,985	5,949.16	15,441.62	1	2.96
10	11,205	4,448.48	19,890.10	1	3.81
11	21,375	8,486.04	28,376.14	2	10.88
13	44,580	17.698.58	46,074.72	1	8.83
14	23,700	9,409.07	55,483.79	1	10.64
15	40,080	15,912.05	71,395.84	1	13.69
16	99,585	39,535.95	110,931.79	1	21.27
17	117,330	46,580.84	157,512.63	1	30.21
18	2,586,545	1,026,876.49	1,184,389.12	3	681.39
21	117,195	46,527.25	1,230,916.37	1	236.07
22	20,565	8,164.46	1,239,080.83	1	237.63
23	5,250	2,084.30	1,241,165.13	1	238.03
24	1,380	547.88	1,241,713.01	1	238.14
25	1,700	674.92	1,242,387.93	2	476.53
27	4,455	1,768.68	1,244,156.61	1	238.60
28	600	238.21	1,244,394.82	1	238.65
29	9,555	3,793.42	1,248,188.24	1	239.38
30	315	125.07	1,248,313.31	1	239.40
31	33,255	13,202.48	1,261,515.79	1	241.93
Feb. 1	390	154.84	1,261,670.63	1	241.96
5	3,600	1,429.23	1,263,099.86	4	968.95
6	50	19.85	1,263,119.71	1	242.24
7	1,315	522.08	1,263,641.79	1	242.34
8	8,120	3,223.71	1,266,865.50	1	242.96
10	1,180	468.48	1,267,333.98	2	486.10
11	790	313.64	1,267,647.62	1	243.10
12	4,630	1,838.15	1,269,485.77	1	243.46
13	6,485	2,574.60	1,272,060.37	1	243.96
14	27,800	11,036.80	1,283,097.17	3	738.21
17	31,540	12,521.61	1,295,618.78	1	248.47
18	228,150	90,577.17	1,386,195.95	1	265.84
19	63,280	25,114.67	1,411,310.62	1	270.66
20	7,250	2,878.31	1,414,188.93	1	271.21
21	5,350	2,124.00	1,416,312.93	4	1,086.48
25	350	138.96	1,416,451.89	1	271.64
26	315	125.07	1,416,576.96	2	543.32
28	2,910	1,155.30	1,417,732.26	3	815.68
Mar. 3	695	275.93	1,418,008.19	1	271.95
4	275	109.18	1,418,117.37	1	271.97
5	2,300	913.12	1,419,030.49	3	816.42
8	475	188.59	1,419,219.58	2	544.36
10	2,075	823.80	1,420,042.88	1	272.34
11	825	327.54	1,420,370.42	1	272.40
Forward	$3,577,695	$1,420,370.42			$13,526.37

(A–6)

Date of Payments	Amount	Proportion to Camb. Subway	Total to Date	Number of Days	Interest
Brought Forward	$3,577,695	$1,420,370.42			$13,526.37
Mar. 12	1,525	605.45	1,420,975.87	1	272.51
13	2,900	1,151.33	1,422,127.02	1	272.74
14	4,400	1,746.84	1,423,874.04	1	273.07
15	27,675	10,987.18	1,434,861.22	3	825.54
18	218,575	86,775.82	1,521,637.04	1	291.82
19	17,125	6,798.76	1,528,435.80	1	293.12
20	625	248.14	1,528,683.94	1	293.17
21	300	119.11	1,528,803.05	3	879.57
24	700	277.91	1,529,080.96	4	1,173.00
28	400	158.81	1,529,239.77	3	879.84
31	475	188.59	1,529,428.36	3	879.93
April 3	675	267.99	1,529,696.35	1	293.37
4	1,575	625.29	1,530,321.64	3	880.47
7	7,275	2,888.24	1,533,209.88	2	588.08
9	200	79.40	1,533,289.28	5	1,470.25
14	4,500	1,786.54	1,535,075.82	1	294.40
15	5,175	2,054.53	1,537,130.35	1	294.79
16	232,125	92,155.27	1,629,285.62	2	624.92
18	17,675	7,017.11	1,636,302.73	3	941.43
21	2,325	923.05	1,637,225.78	2	627.98
23	875	347.39	1,637,573.17	1	314.05
24	325	129.04	1,637,702.21	6	1,884.48
30	425	168.74	1,637,870.95	1	314.11
May 1	125	49.64	1,637,920.59	20	6,282.40
21	200	79.41	1,638,000.00	3 yr, 5 mo. 10 d.	$394,896.30
	$4,125,870	$1,638,000.00			$429,567.71

See Statement of Nov. 1, 1918.

(A–7)

DIVIDENDS DECLARED AND PAID FROM MARCH 23, 1912, TO NOV. 1, 1916.

On 55,000 Shares Stock.

No.		
25	3%	165,000
26	3%	165,000
27	3%	165,000
28	2%	110,000
29	1½%	82,500
30	1½%	82,500
31	1½%	82,500
32	1%	55,000
33	1½%	82,500
34	1½%	82,500
35	1½%	82,500
36	½%	27,500
37	1½%	82,500
		$1,265,000

(A–7)

On 15,600 Shares Stock

27		46,800
28		31,200
29		23,400
30		23,400
31		23,400
32		15,600
33		23,400
34		23,400
35		23,400
36		7,800
37		23,400
		$265,200

See Statement of Nov. 1, 1918.

(B–1)

BOSTON ELEVATED RAILWAY COMPANY

CAMBRIDGE MAIN STREET SUBWAY

ENGINEER'S CONTRACT ESTIMATE OF WORK DONE BY H. P. NAWN CO.

Summary

Regular Work	$5,377,037
Special Construction	109,158
Outside Structures and Equipment	396,971
	$5,883,166

Regular Work

1	Earth Excavation from Sta. 58 + 00 to Prospect St.	233,891	c. y. @	4.00	$935,564
2	Earth Excavation from Prospect St. to Tunnel	23,806	" @	4.50	107,127
3	Earth Excavation in Tunnel	73,444	" @	5.00	367,220
4	" " Tunnel to Eliot Sq. C. H. & Common	185,930	" @	4.75	883,168
5	Rock Excavation	13,630	" @	5.50	74,965
6	Concrete Foundation Wall Main Street Incline	1,636	" @	8.00	13,088
7	Concrete Sta. 58 +00 to Tunnel	80,059	" @	11.00	880,649
8	" in Tunnel	24,126	" @	14.00	337,764
9	" Tunnel to Eliot Sq. C. H. & Common	61,948	" @	12.00	743,376
10	Concrete backing on arch section	500	" @	7.75	3,875
11	Grouting	1,406	" @	15.00	21,090
12	Steel, erecting and riveting	328	tons @	74.00	24,272
13	" beams and placing	2,900	" @	54.00	156,600
14	" rods and placing	7,139	" @	45.00	321,255
15	Waterproofing 4 ply sta.	141,169	s. y. @	1.50	211,754
16	Electric conduits, furnishing and laying in subway	367,202	ft. @	.10	36,720
17	Granolithic station platforms	7,668	s. y. @	1.00	7,668
18	" stairways	73	" @	30.00	2,190
19	" gutters and bases	1,194	" @	2.25	2,687
20	Ribbed tile, backing and partitions	5,000	"	1.20	6,000
21	Enamel tile (Contract)	20,520	+	10%	22,572
22	Plastering	42,704	+	10%	46,974
23	" on wire mesh single course	347	s. y. @	1.30	451
24	Plastering on wire mesh double course	1,450	" @	2.25	3,263
25	Main St. Incline, concrete fence and portal				21,000
26	Cambridge Common Incline, brick wall, portal and platform for Summer Statue				23,000
27	Mt. Auburn Incline, coping, parapet wall and fence				2,700

28 Brick masonry, manholes at pump wells	16 c. y. @ 15.00	240
29 Raising surface of Eliot Sq. and Vicinity	7,610 " @ .50	3,805
30 Underpinning buildings		116,000
		$5,377,037

(B–2)

BOSTON ELEVATED RAILWAY COMPANY

CAMBRIDGE MAIN STREET SUBWAY

CONTRACT ESTIMATE — SPECIAL CONSTRUCTION

Based on Actual Cost

Builder's Hardware	$3,289
Curb and Nosings	5,024
Doors and Windows	23,752
Iron Fences	7,775
Miscellaneous	7,580
Office Furniture	173
Ornamental Work and Bronze	8,182
Plumbing	19,127
Relocating B. & A. Tracks	3,726
Stairs	2,046
Mason Treads	4,899
Ticket Offices	3,224
Center Drain Covers	1,984
Stair and Hand Rails	974
Cut and Polished Stone	16,578
Fifty Concrete Settees	825
	$109,158

(B–3)

BOSTON ELEVATED RAILWAY. COMPANY

CAMBRIDGE MAIN STREET SUBWAY

CONTRACT ESTIMATE — OUTSIDE STRUCTURES AND EQUIPMENT

Based on Actual Cost

Pipe for Under-drain	$3,500
Sewer Changes, Metropolitan	32,500
Sewer Changes, City of Cambridge	235,954
Electric Conduit Changes, B. E.; In Tunnel Harvard Square,	5,395
Electric Conduit Changes, N. E. Telephone & Telegraph Co.	11,251
Water Pipe Metropolitan	20,694
Gas Pipes, Cambridge Gas Light Company	1,140
Restoring Co-operative Society and Abbot cellars	1,415
Harvard Square Shelter	18,231
Harvard Square Exits	2,878
Kendall Square Shelter	10,395
	$343,353
Ballast in place 26,520 tons at $1.65	43,758
Ties distribution only 20,000 tons at .10	2,000
Rails distribution only 8,860 tons at 1.00	7,860
	$396,971

(C–1)

CAMBRIDGE MAIN STREET SUBWAY

Additional Information on Costs

(From Main Street Incline to Portal at Eliot Square Yard).

COST, QUANTITIES, Etc.

(From Boston Elevated Railway Co.'s Records).

Cost to November 1, 1916, including interest, taxes, etc., (without equipment)	$7,073,349.98
Cost to November 1, 1916, including interest, taxes, etc., (with equipment)	$8,258,020.96
(See table A-3)	
Engineer's Estimate on work by contractor. (See tables B-1, B-2, B-3)	5,883,166.00
Net amount paid to contractor	5,409,878.96
Engineer's Estimated Saving	$473,287.04
Contractor's bonus under contract (25 per cent)	118,321.76
Amounts paid contractor:	
Net	$5,409,878.96
Bonus	118,321.76
Total	$5,528,200.72

Note.—This "Total" plus work done by Boston Elevated Railway Departments (amounting to $15,421.06, per Mr. Davies) =

$5,528,200.72
15,421.06

$5,543,621.78

and is shown in Auditor's detailed statement under Item marked "Construction of Tunnel" — per Mr. Davies.

(C–2)

Total Costs, including equipment, etc., as given on table C-1 are made up as follows on Auditor's Statement:

Cost of Construction, Taxes, Engineering, Land, etc.	$7,073,349.98
Equipment (exclusive of rolling stock)	326,725.40
Interest March 23, 1912, to November 1, 1916, on amount paid in by subscribers, less dividends	693,577.87
Interest January 18, 1913, to November 1, 1916, on second amount paid in by subscribers, less dividends	164,367.71
	$8,258,020.96

Note.—Balance on hand unexpended. (See table A-2). November 1, 1916, $336,569.11. (Authorized for Cambridge Subway work only).

(C–3)

COSTS TO NOVEMBER 1, 1916.

(See table A-4)

Engineering and General Expenses		$373,562.58
Right of Way		233,839.62
Former "Real Estate" account	$103,801.17	
Land	60,875.00	
Damages	69,163.45	
Other Land used in Electric Railway Operations		1,018.34
Tunnels		6,030,898.73
Construction of Tunnel:		
$5,528,200.72 to Contractor, (includes certain equipment. See C-4).		
15,421.06 Work done by departments of Boston El. Ry. Co.		
$5,543,621.78		
Removal of under ground structure, (not by Contr.)	$251,183.86	
Temporary Line Changes	37,625.84	
Temporary Track Changes	184,128.40	
Electric Lighting (Initial installation in main subway	14,338.85	
Stations		62,743.80
Engineering and General Expenses	29,995.17	
Harvard Square Escalator	15,373.43	
Lighting installation	11,701.74	
Exit, Central Square	5,256.76	
Signs and miscellaneous	416.70	
	62,743.80	
Taxes during construction		9,125.34
Interest during construction		362,161.57
Total		$7,073,349.98

Note.—In C-1 the Engineer's Estimate includes "equipment" as provided by the Act (see table A-1). This work is not included in Boston subway work, and in making comparative estimates should be omitted, as follows:

(C–4)

EQUIPMENT (Work done by Contractor)

Ballast in place	(table	B-3	$43,758.00
Ties distribution only	"	"	2,000.00
Rails distribution only	"	"	7,860.00
Office furniture	"	B-2	173.00
Plumbing	"	"	19,127.00
Ticket Offices	"	"	3,224.00
50 Concrete Settees	"	"	825.00
Electric Conduits	"	B-1	36,720.00
			$113,687.00

Engineer's Estimate	$5,883,166.00	
Minus Equipment	113,687.00	= 5,769,479.00
Net Amount to Contractor	5,409,878.96	
Minus Equipment	113,687.00	= 5,296,191.96
Saving as before		473,287.04
Bonus as before (25%)		118,321.76

Then

Net Amount to Contractor (Subway, minus equipment)	=	$5,296,191.96
Bonus	=	118,321.76
Total amount to Contractor		$5,414,513.72
Equipment (Work done by Boston Elevated Railway Co.)		
Electric Lighting (Installation) Tunnel	=	$14,338.85
" " " Stations	=	11,701.74
		$26,040.59

TOTAL EQUIPMENT COST DURING CONSTRUCTION
(Without Engineering and Interest

Work done by Contractor	=	$113,687.00
Work done by Boston El. Ry. Co.	=	26,040.59
		$139,727.59

(C–5)

COST OF SUBWAY (Minus Equipment)

The cost of equipment (table C-4) is $139,727.59, to which should be added the proportion of the Engineering and General Expense, and the interest on the cost, in order to get the total chargeable to Equipment. As these items were figured in with the cost of the Subway at the time of construction (as provided for in the Act — see table A-1), the Auditing Department has not kept them separate and Mr. Davies of the Auditing Department agrees that they can only be estimated by proportion.

This estimate is as follows:

(Equipment) 139,727.59 / Total 7,073,349.98 = 7,073,349.98 = 1.975%

.01975

139,727.59.00
70,733.49.98

68,994.09.020
63,660.14.982

5,333.94.0380
4,951.34.4986

382.59.53940
353.66.74990

Engineering and General Expense (table C-3)

373,562.58
29,995.17
403,557.75
.01975

201778875
282490425
363201975
40355775

7970.2655625 = 7,970.27

Interest (table C-3)

362,161.57
.01975

181080785
253513099
325945413
36216157

7152.69 10075 = 7,152 69

Equipment	139,727.59	
Eng. and Gen. Exp.	7,970.27	
Interest	7,152.69	
Total cost of equipment	154,850.55	
Construction cost to November 1, 1916 (table A-4)		$7,073,349.98
Less estimated cost of equipment		154,850.55
		$6,918,499.43

(C–6)

COST PER FOOT — (Includes Stations and all Expenses)

Length of Subway, Bridge to Portal	12,676 ft.
" " " for Surface cars, Cambridge Common Incline to Mt. Auburn Incline	1,699 ft.
	14,375 ft.

Construction cost to November 1, 1916, (see table C-5) = $6,918,499.43
(Including taxes, interest, land, damages, etc., but without items of **Equipment** in order to compare with Boston Subways).

```
          481.29
        ---------
14375 )6918499.43
       57500                 say $481.00 per lin. ft.
       -----
       116849
       115000
       -----
        18499
        14375
        -----
         41244
         28750
         -----
         124940
```

NOTE. — For comparison with Boston Subways see extract from Prof. Swain's letter of February 25, 1916, as follows:

Total lengths and cost per foot of subways in operation.

Tremont Street Subway	8967 feet	$487 per foot
East Boston Tunnel	7480 "	442 " "
Washington St. Tunnel	6110 "	1,313 " "
Cambridge Connection	2486 "	583 " "
Boylston Street Subway	7937 "	629 " "

The figures include stations, property damages, in fact all expenses.

*Dorchester Tunnel	11991 feet	915 per foot

*Not in this report but added on authority of letter B. L. Beal, Sec. Transit Com. dated Feb. 12, 1919.

(D–1)

CAMBRIDGE MAIN ST. SUBWAY

General Data

Cost per linear foot of subway on Main St.
Sta. 73 + 71 to 111 + 00 or 3729 ft.

Compiled from information in Calculation Book 59 by John Ware, Calculation Book 815 by Herbert R. Stearns, and Ledgers A, B and C by H. E. Whiting.

Quantities are those actually figured and returned by inspectors.

*Excavation	32.6 cu. yds. lin. ft. @	$4.00	$130.40
*Concrete	9.9 " " " " "	11.00	108.90
Reinforcement	1097 lbs. per " " "	.0225	24.57
Waterproofing	11.2 sq. yds. " " "	1.50	16.80
Backfill	8.1 cu. yds. " " "	.60	4.86
Changes to Underground Structures			38.66
†Repaving and Surfacing ($11,001.52)			3.00
Elec. Conduits 30 ducts (Est. based on cost B. H. Tunnel			4.10
Construction damages (property)			.18
			331.47
Engineering and General Expense 5.25%			17.40
Total			$348.87

†Boston Elevated Ry. Co. paid City of Cambridge $69,928.92 for repaving entire subway.

35982	sq. yds.	repaving granite block @	$0.70	$25,187.40	$9,426.08
9056	" "	repairing macadam "	.75	6,792.00	
4401	" "	asphalt paving "	2.75	12,102.75	
7751½	" "	brick paving "	2.75	21,316.62	
669	" "	bitulithic paving "	2.75	1,839.75	
6300	lin. ft.	resetting curbstone "	.20	1,260.00	412.40
4470	sq. yds.	relaying brick sidewalk "	.32	1,430.40	1,163.04
Total				$69,928.92	$11,001.52

Includes labor, teaming, dumping, sheeting, pumping and all overhead charges.

City of Cambridge W. W.	$20,364.04	H. E. Whiting's
" " " El. Dept.	2,146.46	Ledgers A, B, C
Cambridge Electric Light Co.	785.24	$42,149.76
Cambridge Gas Light Co.	14,100.49	Paid direct by
N. E. Tel. & Tel. Co.	4,753.53	B. E. Ry. Co.
	$42,149.76	

Sewers proportionate part of

$268,454 $\frac{3729}{9908}$ or 38% $102,012.00

$144,161.76—3729—$38.66

February 15, 1913

February 15, 1913

(D–2)

CAMBRIDGE MAIN ST. SUBWAY

Kendall Sq. Station

Compiled from information in Calculation Book 59 by John Ware, Calculation Book 815 by Herbert R. Stearns, and Ledgers A, B & C by H. F. Whiting.

Quantities are those actually figured and returned by inspectors.

	Quantity	Unit Price	Amount
Granolithic base and gutters	165.0 sq. yds.	2.25	$371.25
Earth excavation	13,332 cu. yds.	4.00	‡43,328.00
Concrete	3,097 cu. yds.	11.00	34,067.00
Plastering (proportion of total cost in stations)			8,100.00
Tiling (Ribbed)	1,000 sq. yds.	1.20	1,200.00
Tiling			3,171.83
Steel bars	436,464 lbs.	2.25	9,820.50
Stairs	8 sq. yds.	30.00	240.00
Granolithic platforms	836 sq. yds.	1.00	836.00
Waterproofing	5,024 sq. yds.	1.50	7,536.00
Changing Underground structures			17,660.00
Repaving and Resurfacing			1,027.60
			127,358.18
Engineering and General Expense,5.25%			6,686.30
Shelters, Exits and Entrances			10,984.00
Engineering and General Expense			576.68
			$145,605.16
Ground area	17,217 sq. ft. — $8.46 Unit costs.		
Platform area	7,823 sq. ft. — $18.61		

‡We note here a $10,000 error, *i. e.*—$43,328 should be $53,328.

Central Sq. Station

Granolithic base and gutters	255.4 sq. yds.	2.25	574.65
Earth excavation	25,142 cu. yds.	4.00	100,568.00
Concrete	7,124 cu. yds.	11.00	78,364.00
Plastering (proportion of total cost in stations)			11,129.00
Tiling (Ribbed)	1,500 sq. yds.	1.20	1,800.00
Tiling			4,862.05
Steel bars	772,954 lbs.	2.25	17,382.40
Stairs	20 sq. yds.	30.00	600.00
Granolithic platforms	1,660 sq. yds.	1.00	1,660.00
Waterproofing	6,500 sq. yds.	1.50	9,750.00
Changing Underground Structures			15,007.00
Repaving and Resurfacing			2,000.00
			243,697.10
Engineering and General Expense 5.25%			12,794.10
Shelters, Exits and Entrances			8,204.86
Engineering and General Expense			430.75
			265,126.81
Ground area	24,648 sq. ft. — $10.75		
Platform area	15,285 sq. ft. — 17,.35 Unit Costs		

(D–3)

CAMBRIDGE MAIN ST. SUBWAY

Cost per linear foot of Tunnel on Massachusetts Ave.
Sta. 131+16 to Sts. 157+48 — 2632 ft.
Compiled from information in Calculation Book 59 by John Ware,
Calculation Book 815 by Herbert R. Stearns, and
Ledgers A, B and C by H. E. Whiting.

Quantitues are those actually figured and returned by inspectors.

*Excavation	28.3 cu. yds. @ $5.00	$141.50
*Concrete	9.17 " " " 14.00	128.38
Reenforcement	430 lbs. per lin. ft. @ $2.25	9.68
Waterproofing (grouting)	.54 yds. per lin. ft. $15.00	8.10
Blackfill	None	
Changes to Underground Structures, None		
Repaving and Resurfacing, None		
Elec. Conduits (based on cost in B. H. Tunnel)		4.10
Construction damages (property)		
		$291.76
Engineering and General Expense 5.25%		15.32
Total		$307.08

*Includes labor, teaming, pumping, sheeting and all overhead charges. February 15, 1913.

(E-1)

GENERAL DATA — BOSTON SUBWAYS

From Boston Transit Commission Reports

Old Subway, 1895-8 — *Two and Four Track*

1.	Total length of subway, 9,498 ft.	
1.A	" " " equivalent single track 28,006 ft. (2nd An. Rep. last p)	
1.B	" " " " double " 14,003 ft.	
2.	Total cost to June 30, 1910 (no exceptions)	4,125,120
3.	" " of damages	349,092
4.	" " less damages	3,776,028
5.	" " of general expenses, engineering and interest	797,693
6.	" " less (3) and (5)	2,978,335
7.	Average cost per foot, less damages using 2-track length	270
7.A	" " " " " " total "	398
8.	" " " " " (3) and (5) " 2-track "	213
9.	" " of damages per foot " " "	25
10.	" " " (5) " " " " "	57

East Boston Tunnel, 1900-4 — *Two Track*

1.	Total length of subway 7,434 ft. (Top of incline to W. end of Subway)	
2.	" cost to June 30, 1910 (no exceptions)	3,243,769
3.	" " of damages	92,091
4.	" " less "	3,151,678
5.	" " of general expenses, engineering and interest	600,166
6.	" " less (3) and (5)	2,551,512
7.	Average cost per foot, less damages	424
8.	" " " " " (3) and (5)	343
9.	" " of damages per foot	12
10.	" " " (5) " "	81

Washington Street Tunnel, 1904-8 — *Two Track*

1.	Total length of subway, 6,060 ft. approx. (scaled 0-96 to 61.56, 12th An. Rep. Page 22)	
2.	Total cost to June 30, 1910 (no exceptions)	8,720,160
3.	" " of damages	2,908,278
4.	" " less "	5,811,882
5.	" " of general expenses, engineering and interest	1,293,798
6.	" " less (3) and (5)	4,518,084
7.	Average cost per foot less damages	959
8.	" " " " " (3) and (5)	745
9.	" " of damages per foot	480
10.	" " " (5) " "	214

COST OF BOSTON SUBWAYS — 2 TRACK REGULAR SUBWAY

General Summary

(See following table)

Old Subway — Sections 6 and 8

East Boston Tunnel — Sections A-F

Washington St. Tunnel — Sections 1-9

Section and Location	Act. Length Incl. Stat.	Equivalent Length Reg. Subway	Cost per ft. Based on Act. L'gth & Total' Total Cost	Cost per ft. Based on Act. L'gth & Total' Less Damages	Cost per ft. Based on Const. cost Only Reg. Subway	Cost per ft. Based on Const. cost Only Sta. S. or D.	Unit Costs Equiv. Lgth. Based on Equiv. Lgth. & Const. cost only Total Less Damages	Earth Ex. pr. cu. yd.	Reinforc. Conc. pr. cu. yd.	Str. Steel in place pr. ft.
6-0 S (a)	1085	1085	302	301	299	$..	301	$..	$..	$..
8- "	495	495	194	194	187	..	194	..	..	..
A-E.B.T.b	819	819	121	121	112	..	121	..	..	..
B- " (c)	4351	4351	316	295	240	..	295	..	..	..
C- " (c)	748¼′	991	660	660	433	1126D	498	..	..	..
D- "	698′	698′	351	351	325		351	..	..	..
E- "	318′	492′	592	592	361	632D	383	..	..	..
F- "	500′	610′	485	485	359	628D	398	..	..	..
Incline W.St.T.	144		1073	3111	74		311	5.24	13.65	2.12
1 W St. T	542½	542½			282			5.61	13.56	37.60
2 "	525	700	1216	692	354	531S	519	5.52	21.22	37.60
3 "	333½	500	1381	951	423d	635S	634	4.89	15.29	60.90d
4 "	1251½	1561½	1841	690	377	565S	553	7.03	14.91	20.60
5 "	1015	1238	1019	812	480	720S	665	6.82	14.96	12.60
6 "	210	311½	1595	1595	768	1152S	1075	6.10	14.82	56.40
7 "	147	220½	948	948	488d	732S	632	5.50	15.00	21.50d
8 "	780	780	790	635	492	..	635	7.87	13.99	10.20
9 "	445½	708	1410	975	428	749D	614	6.97	17.16	56.70

′ Total cost of section, except General Expenses, Engineering and Interest to June 30, 1910.

(a) Tunnel excavation by shield for 550 ft. remainder open cut.
(b) Includes 139 ft. of open incline.
(c) Tunnel excavation by shield under compressed air.
(d) No regular subway, figure based on ⅔ cost of station per foot.
D Double platform station.
S Single " "

COST OF BOSTON SUBWAYS — 2 TRACK

(Average Costs, etc.)

General Summary

(See previous table)

Cost per Linear Foot — Based on Cost of Construction in the Rough

Section	Description	Location	Cost
Av. 6 & 6	Regular Subway, Open Cut′ (p.	Old Subway	$264.00
Part of A	Open Incline (p.	East Boston Tunnel	61.00
" " "	Regular Subway Incline, Open Cut (p.	" "	122.00

Av. B. & C	Regular Subway, Tunnel Shield under air (p.	East Boston Tunnel	263.00
Av. D, E & F	Regular Subway, Open Cut (p.	" "	338.00
Part of 1	Part y Covered Incline (p.	Washington St. Tunnel	74.00
Av. 1-9′′	Regular Subway (exculding Incline) (p.	" " "	412.00
C	Double Platform Sta., Tunnel under air (p.	East Boston Tunnel	1,126.00
Av. E. & F	Double Plattorm Sta., Open Cut (p.	" "	630.00
Av. 2-7	Single Platrorm Sta., Open Cut (p.	Washington St. Tunnel	672.00
9	Double Palttorm Sta., Open Cut (p.	" " "	758.00

Unit Costs — Based on Cost of Construction in the Rough

Av. 1-9	Earth Excavation, per cu. yd. (p. Washington St. Tunnel	6.16
Av. 1-9	Reinforced conc., per cu. yd. (p. Washington St. Tunnel	15.46
Av. 1-9	Structural Steel ′ Placing per lin. ft. (p.	34.90
Av. 1-9	Waterproofing, per sq. yd. (est'd) (p.	1.40

′ Except 550 ft. of tunnel (shield method) on Sec . t
′′ Excluding incline.

(E–4)

January 8, 1912.

COST OF BOSTON SUBWAYS PER LINEAR FOOT

Explanation of Table

Column 1. Total length of section.
" 2. Total cost of section, except General Expenses, Engineering and Interest to June 30, 1910, as found in the summary of subway expenses in the 16th Annual Report of the Boston Transit Commission.
" 3. Cost per linear foot of subway based on Col. 2 divided by Col. 1.
" 4. Total cost of section (Col. 2) less damages and takings.
" 5. Cost per linear foot of subway based on Col. 4 divided by Col. 1.

		1 Length of Sec. Ft.′	2 Total Cost from 16 Annual Report′	3 Cost per lin. Ft.′	4 Total Cost Less Damages and Takings′	5 Cost per Lin. Ft.′
6A	Old Subway — Tremont St.	1085	$327,542	302	$326,977	301
B	" " — Hanover St.	495	95,902	194	95,902	194
Ab	E. Bost. Tun. — Maverick Sq.	819	98,869	121	98,869	121
Bc	" " — Under Harbor	4351	1,374,991	316	1,282,900	295
Cc	" " — State St.	748¼	494,352	660	494,352	660
D	" " — State St.	698′	244,823	351	244,823	351
E	" " — State St.	318′	188,201	592	188,201	592
F	" " — Court St.	500′	242,367	485	242,367	485
1b	Wash. St. Tunnel — Under Bldgs.	686½	736,674	1073	213.192	311
2	" " " — Wash. St.	525	637,698	1216	363,512	692
3	" " " — " "	333½	460,860	1381	317,127	951
4	" " " — " "	1251½	2,304,631	1841	864,982	690
5	" " " — " "	1015	1,034,272	1019	824,571	812
6	" " " — " "	210	335,038	1595	334,903	1595
7	" " " — " "	147	139,466	948	139,415	948
8	" " " — " "	780	616,254	790	496,072	635
9	" " " — Under Bldgs.	445½	627,746	1410	434,712	975

′ See "Explanation of Table," Opposite proper column.
b Includes open incline (Sec. A, 139 ft., Sec. 1, 144′ ft.)
a Tunnel excavations by shield for 550 ft. and remainder in open cut.
c Tunnel excavation by shield under compressed air.

Explanation of Table

Column 6. The equivalent length of regular subway, for any section, equals the length of section plus the length of regular subway equivalent of the excess cost of station (if any) over the cost of regular subway.

" 7. The cost of construction includes the contract work and work done and materials furnished by the Commission in constructing the body of the subway in the rough. It does not intend to cover the approaches to stations or work on structures other than the subway; nor inspection and skilled service of any kind.

" 8. The cost per linear foot of subway based on Col. 7 divided by Col. 6.

" 9. Same as Col. 4.

" 10. The cost per linear foot of subway based on Col. 9 divided by Col. 6.

	6 Equiv. Length Regular Subway'	7 Cost of Construction Only'	8 Cost per Ft.'	9 Total Cost Less Damages and Takings'	10 Cost per Lin. Ft.'
6a Old Subway — Tremont St.	1085	$324,416	299	326,977	301
8 " " — Hanover St.	495	92,638	187	95,902	194
Ab E. Boston Tunnel — Maverick Sq.	819	91,884	112	98,869	121
Bc " " — Under Harbor	4351	1,042,337	240	1,282,900	295
Cc " " — State St.	991	429,563	433	494,352	498
D " " — State St.	698'	226,698	325	244,823	351
E " " — State St.	492'	177,626	361	188,201	383
F " " — Court St.	610'	219,013	359	242,367	398
1b Wash. St. Tunnel — Under Bldg.	686½	163,851	238	213,192	311
2 " " " Wash. St.	700	247,491	354	363,512	519
3 " " " " "	500	211,724	423d	317,127	634
4 " " " " "	1561½	587,951	377	863,982	553
5 " " " " "	1238	594,830	480	824,571	665
6 " " " " "	311½	239,371	768	334,903	1075
7 " " " " "	220½	107,600	488d	139,415	632
8 " " " " "	780	383,621	492	496,072	635
9 " " " — Under Bldgs.	708	303,089	428	434,712	614

' a, b, c See footnotes previous page.
d No regular subway, — figure based on ⅔ cost of station per foot.

(E–6)

January 8, 1912

APPROXIMATE COST OF STATIONS AND REGULAR SUBWAY PER FOOT

Assuming that the relative *cost* of stations and regular subway per foot, in open cut, varies as their respective outside widths. For relative cost of stations and regular subway in tunnel, see p.

Boston Subways

Section and Location	Approx. Length of Sta.	No. of Platforms	Cost ratio of Sta. to Subway	Equiv. Length of Regular Subway	Length of Regular Subway	Equivalent Total L'gth Subway	Total Cost of construction in rough	Construction Cost per ft. Sta.	Reg. Subway
6-Old Subway	(a) None	..	..	..	1085a	1085a	$324,416	..	299a
8- " "	"	..	..	..	495	495	92,638	..	187
A-E. Bos. Tunnel	"	..	..	..	619b	619b	91,854	..	112b
B- " "	(c) "	..	..	..	4351c	4351c	1,042,337	..	240c
C- " "	(c) 151¾	2	2.6	394½	596½c	991c	429,583c	1126c	433c

D-	"	"	None	..	..	..	698′	698′	226,698	..	325
E-	"	"	232′	2	1.75	406′	86′	492′	117,626	632	361
F-	"	"	146′	2	1.75	256′	354′	610′	219,013	628	359
Incl Wash. St. Tun.			None	..	..	..	144′	..	10,650f	..	74e
1 "	"	"	"	..	..	..	542½	542½	153,201f	..	282
2 "	"	"	350	1	1.5	525	175	700	247,491	531	354
3 "	"	"	333½	1	1.5	500	None	500	211,724	635	423d
4 "	"	"	620	1	1.5	920	631½	1561½	587,951	565	377
5 "	"	"	445	1	1.5	667½	570	1237½	594,830	720	480
6 "	"	"	203	1	1.5	304½	7	311½	239,371	1152	768
7 "	"	"	147	1	1.5	220½	None	220½	107,600	732	488
8 "	"	"	None	..	..	..	780	780	283,621	..	492
9 "	"	"	350	2	1.75	612½	95½	708	303,089	749	428

AVERAGE COST PER FOOT OF STATIONS AND REGULAR SUBWAY

(Summary from the following page)

(a) Tunnel excavation by shield for 550 feet; remainder open cut.
(b) Includes 139 feet of open incline.
(c) Tunnel excavation by shield under compressed air.
(d) No regular subway figure based on ⅔ cost of station per foot.
(e) Open incline.
(f) Total cost of Section 1 divided approximately between incline and regular subway.

(F–1)

Dec. 12, 1916.

Subdivision and Classification of Total Payments to the Hugh Nawn Contracting Company, in connection with the construction of the Cambridge Main Street Subway, exclusive of Bonus.

Labor	$2,673,400.79
Teaming	549,656.44
Cement	518,226.93
Broken Stone	336,439.66
Lumber	319,000.38
Steel Bars	236,669.05
Machinery	152,060.19
Structural Steel	140,895.41
Insurance	118,081.29
Sand,	98,871.19
Tar and Felt	61,765.26
Hardware	52,711.01
Lighting and Power	46,625.18
Plastering	43,169.24
Salaries	35,492.52
Granite, Limestone, etc.	33,266.72
Enamel tiling	23,029.72
Fuel	22,303.85
Plumbing	20,970.26
Doors and Windows	19,425.83
Rent	16,706.87
Iron Pipe	15,891.45
Sewer Pipe	15,003.31
Push Rods and Fillers	14,248.12
Shoring Buildings	13,809.18
Sewer Brick	13,177.09
Tunnel Shield	10,860.00
Miscellaneous	10,170.54
Special Sidewalks	9,860.28
Nails	9,816.16
Paving Brick	8,535.17
Oil	8,405.09
Steel Centers	8,228.00
Water Supply and Rates	8,047.17
Ladders, Gates, Fences, etc.	8,002.46
Signs, etc.	5,112.25
Treads and Risers	4,898.56
Wooden Piling	4,149.98
Curbing and Flagging	3,941.47
Ornamental Supplies	3,482.84
Concrete Pointing	3,468.64
Ticket Offices	3,324.15
Steel Piling	3,295.32
Telephone	3,090.43

(F–1)

Builder's Hardware	3,046.08
News Stands	2,856.18
Sewer Fittings	2,825.31
Clinton Wire Fabric	2,490.15
Steel Rails	2,431.57
Hollow Tiling	2,354.01
Gratings, Castings, etc.	2,061.48
Damage Payments	1,942.49
Iron Stairs	1,605.60
Heating Plant	1,530.54
Stationary	1,518.52
Gravel	1,385.48
Roofing, Skylights, etc.	1,303.06
Stoves and Stove Pipe	1,252.32
Hand Rails	1,113.49
Siding at B. & A. Yard	960.36
Relocation of B. & A. Tracks	895.12
Office Furniture	839.49
Painting	716.36
Disinfectant and Lime	627.07
Acroteria and Consols	577.50
Moving Tunnel Shield	551.10
Total	$5,742,468.73

From this total there should be deducted the following credits in determining the net cost of work done by the Hugh Nawn Contracting Co.:

(F–2)

CREDITS

Machinery and Miscellaneous Material sold	$46,792.90	
Material returned to Metropolitan Water and Sewerage Board	12,164.87	
Filling sold	9,653.19	
Sewer Betterment paid by City of Cambridge	7,733.14	
Scrap Iron and Steel sold	2,741.46	
Lumber sold	1,739.18	
Rent from Dyar Supply Co.	1,705.00	
Material sold to Dyar Supply Co.	1,075.63	
Material sold to Paul Winsor	409.78	
Spur Track material sold to B. & M. R. R.	374.86	
Pipe and Rail sold	296.23	
Material sold to Robert Winsor	270.00	
Old Buildings sold	230.00	
Miscellaneous material sold	139.49	
		$85,325.73

(F–3)

Material delivered, Miscellaneous Work Done and Machinery Used on Various Work of the Boston Elevated Railway Co., as follows:

Eliot Sq., Car House	$147,991.44
Beacon Hill Tunnel	14,826.38

(F-3)

East Cambridge Extension	9,475.50	
Cambridge Bridge	4,343.99	
South Boston Power Station	3,071.96	
Sullivan Sq. Changes	2,463.24	
Ballast at Eliot Sq. Car House	2,221.56	
Steel Shop at 510 Main St., Cambridge	2,043.53	
Lechmere Square	1,916.56	
Elevated Road Dept.	1,689.47	
Elevated and Subway Construction Dept.	1,538.84	
Lincoln Power Station	1,375.00	
Maintenance of Way Dept.	1,039.03	
Charles River Viaduct	920.68	
Green St. Station	724.71	
Dover St. Station Changes	310.23	
Wires and Conduits Dept.	262.42	
Miscellaneous	256.00	
Building Dept.	197.50	
		196,668.04

Machinery and Meterial delivered to the Hugh Nawn Contracting Co.,—Cash collected by the Hugh Nawn Contracting Co. and Adjustment of Teaming and Bond Accounts.

Cash collected for Material sold	$11,933.90	
Overpayment acct. Teaming (Watering Carts)	11,050.50	
Machinery (Final Appraisal)	8,778.78	
Material Used on Boylston St. Subway	5,514.92	
Material Used on Miscellaneous Jobs	3,569.66	
Machinery	3,509.14	
Premium on Bond (Paid originally by Boston Elevated Ry. Co.)	2,750.00	
Empty Cement Bags	1,337.27	
Teaming for Stone and Webster	990.12	
Material Used at Rosseter St.	562.57	
Stone Crusher sold to Robt. Winsor	500.00	
Miscellaneous	99.14	
		50,596.00
Total Credits		$332,589.77

(F-4) Dec. 12, 1916.

Total Paid the Hugh Nawn Contracting Co.,	$5,742,468.73
Credits as above	332,589.77
Net Cost of Work Done by the Hugh Nawn Contracting Co.	$5,409,878.96
Engineer's estimate of Cost of Cambridge Main Street Subway	$5,883,166.00
Net Cost of Contractor's Work	5,409,878.96
Estimated Saving	$473,287.04
Bonus Paid Contractor	118,321.76

(G–1)

ANALYSIS OF CAMBRIDGE SUBWAY ENGINEER'S ESTIMATE.

EARTH EXCAVATION, ITEM NO. 1

From Boston El. Ry. Co. Records.

4th Avenue Subway Brooklyn, New York (1908)

Excavation done under similar conditions to Cambridge Main Street Subway, on Main Street. (Open cut traffic not maintained, except in part.)

Average contract price for excavation above mean high water on 1,085,560 cu. yds. was $3.14 per cu. yd.

Average contract price for excavation below mean high water, on 218,200 cu. yds. was $4.61 per cu. yd.

Applying these figures to Cambridge Subway in proportion 46% above and 54% below M. H. W. gives $3.94 per cu. yd. not including repaving or underpinning.

Repaving, Cambridge Subway, Boston El. Ry. Co. paid to City of Cambridge, on this section of the work.

$$\frac{3.00}{32.6} = .0925 \text{ per cu. yd.}$$ (See table D-1).

Underpinning not included as carried under separate item.

Note: Taking 3.94 average price per cu. yd. + .09 for repaving = $4.03

Washington Street Tunnel, Boston.

From Boston El. Ry. Co. Records.

Information from Boston Transit Commission reports and Mr. E. S. Favis.

10 sections, average contract price $4.51 per cu. yd. Underpinning not included.

Note: This excavation was done under more difficult conditions than on the Main Street section of the Cambridge Subway, and the Engineer has used the price of $4.00 per cu. yd., which appears to be reasonable.

(G–2)

EARTH EXCAVATION ITEM NO. 2

From Prospect St. to Tunnel.

From Boston El. Ry. Co. records.

This item was estimated at $4.50, an increase of .50 per cu. yd. over the open cut section east of Prospect Street, as the work was carried on with traffic maintained, necessitating bridging the street under car tracks and roadway.

Note: This price appears to be based on the Washington Street Tunnel, Boston, where the average price was $4.51 per cu. yd. It also includes about .09 per cu. yd. for repaving, and appears to be reasonable.

EARTH EXCAVATION ITEM NO. 3

In Tunnel. (Dana Hill)

From Boston El. Ry. Co. records.

A comparison of Dana Hill Tunnel, Cambridge and Beacon Hill Tunnel, Boston.

Both in hardpan, practically no water.

Both shields cost practically the same per cu. yd.

Both tunnels constructed at practically the same time.

No yard expense on Beacon Hill Tunnel as Commission allowed contractor use of land taken.

From appendix CC of the Boston Transit Commisssion report for the the year ending June 30, 1909, contractor's bid was $4.55.

Note: The Engineer used the price of $5.00 per cu. yd., but the $4.55 per cu. yd. had been used in the new estimate.

(G–3)

EARTH EXCAVATION ITEM NO. 4.

Tunnel to Eliot Sq., C. H. and Common

From Boston El. Ry. Co. records.

See Page D-1.

The amount chargeable to repaving on this section of the work is as follows:

Excavation in items 1 and 2 total to 257,697, cu. yds. which at .09 per cu. yd. amounts to $23,192.73.

The remaining excavation outside of tunnel is shown in items 4 and 5 and total to 199,560 cu. yds.

$69,928.92 Total paid City of Cambridge for repaving (See D-1).

```
                23,192.73
              ------------
199,560)    46,736.19        .234 per cu. yd. repaving.
            39,912.0
            ---------
             6,824.19
             5,986.80
            ---------
               837.390
```

The excavation in item No. 4 was much more difficult than excavation on item 2 (where excavation was taken at $4.50 per cu. yd) especially at Harvard Square Station, which was constructed in small slices, in order to maintain traffic in Harvard Square. Taking the additional cost of repaving at the rate of 23c. instead of 9c. per cu. yd. the increase for repaving is 14c. per cu. yd. which added to $4.50 gives a total of $4.64.

Note: The Engineer's estimate for this item was $4.75, but I have used $4.65 in the new estimate.

(G–4)

ROCK EXCAVATION ITEM NO. 5

From Boston El. Ry. Co. Records.

Metropolitan Sewerage Works, rock excavation was paid for at the same price as earth excavation plus an additional amount for rock, or at an average total price for rock excavation of $5.59 per cu. yd.

Tri-Borough Subways, New York (1909). Average of lowest bidders on 16 different sections was $4.87 per cu. yd. This, however, did not include restoring street surface.

Note: This item was taken on the Engineer's estimate at $5.50 per cu. yd. based as above on work in this vicinity and this figure is used in the new estimate.

CONCRETE FOUNDATION WALL ITEM NO. 6

Main Street Incline

From Boston El. Ry. Co. Records.

1.3.6. concrete.

New York Barge Canal, the price per cu. yd. was	$6.08
Detroit River Tunnel " " " " " "	7.23
	2)13.31
	6.65 average.

Note: No Boston prices on this mixture of concrete found in records. The Engineer's estimate for this item was $8.00, which appears to be reasonable.

(G–5)

CONCRETE ITEM NO. 7

Sta. 58-00 to Tunnel

1.2.4. concrete.

From Boston E. Ry. Co. Records.

4th avenue Subway, Brooklyn,	$10.85 per cu. yd.
4 sections Tri-Borough Subway, New York	11.30 " " "
10 sections Washington Street Tunnel, Boston	10.77 " " "
	3)32.92
	10.97 average.

Note: The Engineer's estimate for this item was $11.00 but $10.50 has been used in the new estimate as being more reasonable for the Cambridge work.

CONCRETE ITEM NO. 8

In Tunnel.

1.2.4. concrete

From Boston El. Ry. Co. Records

The average bid of 12 bidders for similar work on Beacon Hill Tunnel, Boston, built at the same time as the Cambridge Subway, was $12.71, and the contract price was $10.00.

Note: This item is for concrete in tunnel section built by shield, and includes special work at two emergency exits and ventiliating shafts. The Engineer's estimate for this item was $14.00, which appears to be high, whereas in the opinion of the Engineer in charge of the Beacon Hill Tunnel work the contract price of $10.00 was too low for work of that character. The price of $12.00 was considered more reasonable and has been used in the new estimate.

(G–6)

CONCRETE ITEM NO. 9

Tunnel to Eliot Square C. H. and Common.

From Boston El. Ry. Co. Records. *1.2.4. concrete.*

This item includes all concrete in sections west of tunnel at Remington Street and also includes all concrete for Harvard Square Station, covering special work in passageways, shafts, and all concrete encasing steel beams, and trough floor construction. The amount of this station concrete work appears to be estimated at from ⅓ to ½ of the whole of this item, according to the limits considered as within the station.

Note: The Engineer's estimate for this item was $12.00 per cu. yd., an increase, on account of the special work involved, of $1.00 a yard over the amount estimated for concrete on the Main street section. The price of $11.00 has been used in the new estimate.

CONCRETE ITEM NO. 10

Backing on Arch Section

From Boston El. Ry. Co. Records. *1.4½.9. concrete.*

This concrete backing was used on the haunches of the arch section on Main street and is figured at 25c. per yard less that Item No. 6, as it is a leaner mixture.

Note: The Engineer's estimate for this item was $7.75 per cu. yd. and this figure has been used in the new estimate.

(G–7)

GROUTING ITEM NO. 11

From Boston El. Ry. Co. Records.

This item covers grouting used to fill voids in the earth behind the sheeting. West of the tunnel grout pipes were put in as the construction proceeded for this purpose. The mixtures used were from a neat cement to a 1.1 mixture. Grouting was also done in tunnel.

Note: No data appears in the records as to the price per cu. yd. for similar work at that time. The Engineer's price was $15.00 per cu. yd. which appears to be reasonable.

(G–8)

STEEL ITEMS NO. 12 and NO. 13

Erecting and Riveting Beams and Placing

From Boston El. Ry. Co. Records.

Note: The tabulation given below is taken from Boston El. Ry. calculation book No. 815, page 88, and it is evident that the above items *should be reversed*, i. e., the *riveted steel* should be the larger amount and the *plain beams* should be the smaller amount. The amounts also should be slightly changed.

	Pounds	
	3,857,733	Structural shapes.
Fabrication if any	802,000	For trough floor.
done by B. E. Ry.	697,480	Plain Beams.
Co. Shop Main St.	31,364	Kendall Square Shelter.
	5,316	
Fabricated outside	655,483	
Beacon Hill Approach	6,229	(Credit to Subway).
Miscellaneous	28,430	
	6,084,035	
Balance manholes covers, fences, etc.	367,000	
	*6,456,732	*This total, evidently wrong, should be 6,451,035 minus 6,229 (Credit)
		6,444,806 lbs. or 3,222 tons.

Note: From the above it is evident that the 697,480 lbs., or 349 tons, should have been taken as *plain* beams on the estimate, instead of as *rivited steel.*

The items then would read:

Steel, erecting and riveting	2,873 tons @	$74	$212,602.00
Steel, beams and placing	349 " "	$54	18,846.00
Total for two items			$231,448.00
As appearing on Engineer's estimate			180,872.00
Increase			$50,576.00

There would have been an increase of $50,576.00 had the items been taken at their proper quantities, but for purposes of comparison the new estimate has been made with the quantities as used in the Engineer's estimate, except that prices are reversed.

In this connection it may be noted that prices bid on the Tri-Borough Subway, New York, at about this time, averaged $90.00 per ton for riveted steel and $80.00 per ton for beams in place.

(G–9)

STEEL ITEM NO. 14
Rods and Placing

From Boston El. Ry. Co. Records.

4th Avenue Subway, Brooklyn, (1908).

The average contract price for rods in place was $49.29 per ton.

Tri-Borough Subway, New York. (1910).

The average of the lowest bids on 22 sections for rods in place was $65.00 per ton.

Washington Street Tunnel, Boston.

Average cost of material $33.20 per ton.
" " " setting 14.10 " "

47.30 per ton in place.

The Engineer's estimate was made up as follows:

Cost of material	$32.40	per ton.
Cost of setting	12.60	" "
	$45.00	per ton.

Note: The price used in the Engineer's estimate, $45.00 per ton, appears to be low. A figure of $47.00 or $48.00 per ton would seem to be a more reasonable price. I have, however, used the figure of $45.00 per ton in the new estimate.

WATERPROOFING ITEM NO. 15

4 ply

From Boston El. Ry. Co. Records.

10 sections Washington Street Tunnel, Boston.
Average contract price $1.40 per sq. yd.
4th Avenue Subway, Brooklyn, (1908) 3 sections,
Average contract price $1.50 per sq. yd.

Note: The Engineer's estimate is taken at $1.50 per sq. yd., but $1.40 per cu. yd. has been used in the new estimate.

ELECTRIC CONDUITS ITEM NO. 16

Note: This item would not be used on work on Boston Subways, as it is considered part of the equipment. It is therefore omitted on the new estimate, and the amount deducted from the Engineer's estimate.

(G–10)

GRANOLITHIC ITEM NO. 17

Station Platforms

From Boston El. Ry. Co. Records.

No data appears as to costs of other work at the time the Cambridge Subway was under construction.

The estimate was made as follows:

2 in. thick	1.2.4.	at	$11.00	per cu. yd.	$22.00
1 " "	1.2	"	14.00	" " "	14.00
					36.00
				Average	$12.00

3 in. thick—3/36 or 1/12 cu. yd. per sq. yd.
Cost per square yard—1/12 of $12.00 or $1.00.

Note: The Engineer's estimate was taken at $1.00 per sq. yd. and the same figure has been used in the new estimate.

CRANOLITHIC ITEM NO. 18

Stairways.

Average thickness *5 in.*

From Boston El. Ry. Co. Records.

This item was given at *73 s. y.* and from the calculation book it totals to *73 c. y.* and is evidently a typographical error in the Engineer's estimate.

No data appears as to costs per cu. yd.

Note: The Engineer's estimate was taken at $30.00 per cu. yd. and the same figure has been used in the new estimate.

GRANOLITHIC ITEM NO. 19

Gutters and Bases

Av. thickness *3 in.*

From Boston El. Ry. Co. Records.

No data appears as to costs per cu. yd. on other work, but the price of $27.00 per cu. yd. was taken, giving a price of $2.25 per sq. yd.

Note: The Engineer's estimate was taken at $2.25 per sq. yd. and the same figure has been used in the new estimate.

(G–11)

RIBBED TILE ITEM NO. 20

Backing and Partitions

From Boston El. Ry. Co. Records.

Quantities from B. E. R. Co. calculation book No. 815.

Kendall Square Station	1,000	sq. yds.	2″ tile
Central " "	1,500	" "	2″ "
Harvard " "	2,500	" "	2″ "
	5,000		

The estimated cost was $1.20 per sq. yd.

Note: Similar work in Boston (as shown in Boston Transit Commission reports) was as follows:

18th Annual Report, page 199, cost delivered .035 per sq. ft. or 32c. per sq. yd.

14th Annual Report, Page 88, cost of setting 58c. per sq. yd., giving a total of 90c. in place.

Where plaster backing is used in Boston work the average price is about $1.20 per sq. yd.

Note: The Engineer's estimate was $1.20 per sq. yd., and this price has been used in the new estimate.

(G–12)

ENAMELED TILE ITEM NO. 21

(Contract)

From Boston El. Ry. Co. Records.

Calculation book No. 815, page 24.

Kendall Square Station	360	sq. yds. at	$3.92	$1,411.20
Central " "	685	" " "	4.05	2,774.25
Harvard " "	1,760	" " "	3.84	6,758.40
Average			$3.90	$10,943.85

In addition is given in detail colored border 5/12″ and 3″ wide, curved corners, signs, letters, etc., in tiling, plus the contractor's other material, in all amounting to . . . 7,719.78

$18,663.63

Plus 10% to contractor 1,866.37

$20,530.00

Note: Similar work in Boston (as shown in Boston Transit Commission reports) was as follows:

18th Annual Report, p. 204, small amount at $8.50 per sq. yd.
" " " " 201, 780 sq. yds. at $3.85 per sq. yd.
14th " " " 97, bids from $5.49 to $5.57 per sq. yd.

The Engineer's estimate gives the above item at $20,520.00. (Evidently a typographical error of $10.00) to which he adds 10%. I have taken the net figure in the new estimate, omitting the additional 10%.

(G–13)

PLASTERING ITEM NO. 22

From Boston El. Ry. Co. Records.
Calculation book No. 815 and other records.

22,350 sq. yds. in stations (including all work at corners etc., and all materials) at $1.09	$24,431.00
Prices without materials or staging, for above { Plastering 59c. per sq. yd. Round corners 25c. per 1. ft. Square corners 8c. per 1. ft.	
447 sq. yds. Ceiling in exits, shelters, etc., at $1.30	531.00
Extra work around electric chases, signs, and pointing at tiling, labor and materials	17,692.00
	$42,704.00*

*This figure includes 10% to contractor.

Note: Similar work in Boston (as shown in Boston Transit Commission reports, was as follows:

18th Annual Report, page 106, bids 64c. to $1.90 per sq. yd. page 208. bids for round corners 10c. to 35c.

The Engineer's estimate gives the above item at $42,704.00, to which he adds 10%. I have taken the net figure in the new estimate, omitting the additional 10%.

(G–14)

PLASTERING ITEM NO. 23

On Wire Mesh Single Course

From Boston El. Ry. Co. Records.

347 sq. yds. at $1.00 (Sub-contractor's price without staging, sand and cement)	$347.00
Plus 10% to contractor	34.70
	$381.70
Cost of staging, sand and cement, including contractor's commission, do not appear in detail—taken at $70.00	70.00
	$451.70

Note: The Engineer's estimate gives this item at $451.00, which appears correct, the item being 347 sq. yds. taken at $1.30 which price is used in the new estimate.

PLASTERING ITEM NO. 24
On Wire Mesh Double Course

From Boston El. Ry. Co. Records.

This plastering was under trough floor in Harvard Square Station, which was constructed with two layers, having air space between for the purpose of deadening the sound.

Note: The Engineer's estimate gives this price at $2.25 per sq. yd. which appears to be reasonable.

(G–15)

MAIN STREET INCLINE, ITEM NO. 25
Concrete Fence and Portal

From Boston El. Ry. Co. Records.

Calculation book No. 815, page 36.

Rockport chips	$2,309.00
Cement and other material	2,934.00
Labor, concrete	3,711.00
Labor, forms	3,063.00
Acroteria	633.00
Stone curb	3,226.00
Cutting concrete	3,469.00
Trolley bases	143.00
Bronze	343.00
Lamp tips	978.00
	$20,809.00
Add for painting, estimated	191.00
	$21,000.00

Calculation book shows a total of 662 cu. yds., which would give an average price of $31.72 per cu. yd.

Note: The Engineer's estimate gives this item at $21,000.00, which appears to be correct. The price per cu. yd. is reasonable for this class of work.

CAMBRIDGE COMMON INCLINE, ITEM NO. 26
Brick Wall, Portal and Platform for Sumner Statue

From Boston El. Ry. Co. Records.

Calculation book No. 815, page 36.

Bricks	$1,738.00	Special brickwork 114 cu. yds. Lgth. 745 lin. ft.	
Labor	6,606.00		
Granite and limestone	10,963.00	Concrete portal and Sumner Statue 133 cu. yds. at $12	$1,596.00
Miscellaneous Cement, Lime, Lead, etc.	1,045.00		
Lamp Posts and erecting	225.00	Grading on Common, 12 men, 18 d. at $2.20	475.00
	$20.577.00		$2,071.00
Inc. 10%	2,071.00		
	$22,648.00		

Note: The Engineer's estimate gives this figure at $23,000.00 and this amount is used in the new estimate.

(G–16)

MT. AUBURN INCLINE, ITEM NO. 27

Coping, Parapet Wall and Fence

From Boston El. Ry. Co. Records.

Calculation book No. 815.

Concrete coping 23 cu. yds. at $20.00	4,600.00
Brick wall, est	500.00
Iron fence	1,546.00
Grading	150.00
	$2,656.00

Note: The Engineer's estimate gives this figure at $2,700.00, and this amount is used in the new estimate.

BRICK MASONRY, ITEM NO. 28

Manholes at Pump Wells

Note: The Engineer's estimate gives this item at $15.00 per cu. yd.. and as this price appears low $18.00 is used in the new estimate.

RAISING SURFACE, ITEM NO. 29

Eliot Square and Vicinity

From Boston El. Ry. Co. Records.

The surface was raised from Sta. 177 +50 to Sta. 186 +50, the quantity being 7,210 cu. yds.

Note: The Engineer's estimate gives this figure at 50c. per cu. yd., which appears reasonable. This figure is used in the new estimate.

(G–17)

UNDERPINNING BUILDINGS, ITEM NO. 30

From Boston El. Ry. Co. Records.

Frontage of buildings underpinned:

North side Brattle St. (Double value)	450 ft.
Abbot Building, Harvard Square	195 "
Hampden Hall	110 "
Bldgs. S. E. corner Central Square	125 "
Buildings at Lafayette Square	120 "
	1000 ft.

No figures on *Boston work* of a similar nature appear on the records.

Tri-Borough Subway, New York, the average of 12 lowest bidders for underpinning buildings less that 7 stories high was $116 per lin. ft.

Note: The Engineer's estimate gives this item at $116 per lin. ft. and this figure has been used in the new estimate.

(G–18)

NEW ESTIMATE—Regular Work

Item	Description	Quantity	B. E. Ry. Engrs. Price	B. E. Ry. Engrs. Total	New Price	New Total
1	Earth excav. open cut	233,891 c. y.	$4.00	$935,564	$4.00	$935,564
2	" " under traffic	23,806 " "	4.50	107,127	4.50	107,127
3	" " in Tunnel	73,444 " "	5.00	367,220	4.55	334,170
4	" " to portal	185,930 " "	4.75	883,168	4.65	864,575
5	Rock excavation	13,630 " "	5.50	74,965	5.50	74,965
6	Concrete 1.3.6.	1,636 " "	8.00	13,088	8.00	13,088
7	" Main St. 1.2.4.	80,059 " "	11.00	880,649	10.50	840,620
8	" in Tunnel 1.2.4.	24,126 " "	14.00	337,764	12.00	289,512
9	" tunnel to Eliot Sq. 1.2.4.	61,948 " "	12.00	743,376	11.00	681,428
10	" backing to arch 1.4½.9.	500 " "	7.75	3,875	7.75	3,875
11	Grouting	1,406	15.00	21,090	15.00	21,090
12	Steel, erecting and riveting	328 tons	74.00	24,272	54.00	17,712
13	Steel beams and placing	2,900 "	54.00	156,600	74.00	214,600
14	" rods and placing	7,139 "	45.00	321,255	45.00	321,255
15	Waterproofing	141,169 s. y.	1.50	211,754	1.40	197,637
16	*Electric conduits	367,202 ft.	.10	36,720	*	*
17	Granolithic Station platforms	7,668 s. y.	1.00	7,668	1.00	7,668
18	Granolithic stairways	73 s. y.	** 30.00	2,190	30.00	2,190
19	Granolithic gutters and bases	1,194 s. y.	2.25	2,687	2.25	2,687
20	Ribbed tile, backing and partitions	5,000 " "	1.20	6,000	1.20	6,000
21	Emanel tile (Contract)	$20,520	+10%	22,572	Net. Amt.	20,520
22	Plastering "	42,704	+10%	46,974	" "	42,704
23	Plastering on wire mesh single course	347 s. y.	1.30	451	1.30	451
24	Plastering on wire mesh double course	1,450 " "	2.25	3,263	2.25	3,263
25	Main St. Incline, concrete fence and portal			21,000	....	21,000
26	Cambridge Common Incline, Brick wall, portal and platform for Sumner Statue			23,000	....	23,000
27	Mt. Auburn Incline, coping parapet wall and fence			2,700	....	2,700
28	Brick masonry, manholes at pumpwells	16 c. y.	15.00	240	18.00	288
29	Raising surface of Eliot Square and vicinity	7,610 " "	.50	3,805	.50	3,805
30	Underpinning buildings			116,000		116,000
				$5,377,037		$5,169,494
					Ex. wk.	
	*Less equipment			36,720	3%	155,085
				$5,340,317		$5,324,579

Notes: *Item 16, electric conduits, deducted as equipment and not in new estimate.

**Item 18, quantity should read "c. y." instead of "s. y." as shown.

Extra work 3% added to new estimate as it is included on B. E. Ry. Engrs. estimate.

For full details of quantities and prices in each item see analysis of bids on tables G-1 to G-17, inclusive.

(H–1)

CONTRACT AND BOND FOR CONSTRUCTION CAMBRIDGE SUBWAY

This AGREEMENT made this thirty first day of March, 1909, between the BOSTON ELEVATED RAILWAY COMPANY (hereinafter called the "Company") and the HUGH NAWN CONTRACTING COMPANY (hereinafter called the "Contractor").

WITNESSETH as follows:

First: The Contractor shall construct for the Company the Main Street Subway, so called, together with its appurtenances which the Company is authorized to construct under the provisions of Chapter 520 of the Acts of 1906. It is not to lay or re-lay tracks or such conduits, sewers and pipes which the Company may contract with the City of Cambridge or with some other Company, other than the Contractor to re-lay. Said work of construction shall be begun at such time and proceed in such manner as may be directed by the Company, and shall be performed in accordance with the plans and specifications from time to time furnished by the Company, and in all respects subject to its direction. The Contractor shall make no sub-contracts except with the consent of the Engineer of the Company.

Second: The Contractor agrees to procure and carry at all times liability insurance protecting the Company and the Contractor against damage to the employees of the Contractor, and to other persons, and against damage to property, to such extent as is usually covered by such kind of insurance.

Third: The Contractor agrees to hold the Company harmless and indemnified against any loss or damage to person or property occasioned by the negligence of itself, its sub-contractors or employees, which may not be covered by the insurance mentioned in paragraph Second.

Fourth: The Contractor agrees to furnish the Company with bonds aggregating the sum of one hundred thousand dollars ($100,000), signed by a Surety Company or Surety Companies satisfactory to the Company, to secure the due and faithful performance of this contract by the Contractor.

Fifth: The Contractor agrees that the personal time and skill of its President, Henry P. Nawn, shall be devoted to the work of construction herein provided for, and that it will furnish for the said work its skilled superintendents and foremen and office force.

Sixth: The Company agrees to pay to the Contractor for the construction of said subway, as above provided, a sum equal to the cost thereof, as hereinafter defined, plus ten (10) per cent, subject, however, to the provisions of section Thirteen.

Seventh: The cost of the subway and its appurtenances, for the purpose of the preceding paragraph, shall include:

(a) Only the actual cost of all materials used, and all labor employed in said construction, including in the word "labor" the wages and salaries of all foremen, superintendents, engineers and office force employed by the Contractor, but not including any charge for the personal services of the President of the Contracting Company.

(b) The actual cost of all machinery, tools and appliances purchased for and used in the work, less their value upon the completion of the work,

as agreed to by the Company and the Contractor; in case they cannot agree, the value is to be determined by arbitration, one arbitrator to be selected by each party and the third by the two so chosen. The actual cost is not to include the cost of small tools such as picks, crowbars, shovels, hammers of all kinds, rammers, saws, levels, malls, mallets, water pails, chain, ropes, and carpenter's and mason's tools, which are to be furnished by the Contractor, but including all machinery such as steam drills, iron worker's tools, and water-proofing outfits; all machinery shall become the property of said Contractor at the termination of the contract.

(c) The cost of liability insurance carried by the Contractor, in accordance with the provisions of the Second paragraph.

(d) Interest at the rate of five per cent, (5%) per annum on all sums expended by the Contractor of the character mentioned in (a), (b) and (c), until the repayment of the same by the Company. It is understood, however, that requisitions shall be promptly made by the Contractor on the Company, and that no interest under this item shall be included in the cost except in cases where the Company had delayed the payment of the amount of any requisition beyond ten (10) days.

Eight: All materials and machinery purchased by the Contractor for the work herein described shall be purchased in such quantities, and of such quality, and at such prices as may be approved by the Engineer of the Company.

Ninth: The Contractor shall submit each week a statement, with duplicate vouchers, showing the items of cost which have been incurred by it during the preceding week, and the Company shall within ten (10) days reimburse the Contractor for such items of cost, and shall, in addition, pay to the Contractor an amount equal to eight per cent (8%) thereof, and shall in addition hold in its treasury as a part of the compensation of the Contractor an amount equal to two per cent (2%) of said cost until sixty (60) days after final completion of the work and the production of evidence satisfactory to the Company that there are no liens thereon or claims against the Company or the Contractor on account of the work provided for herein, when said amount retained is to be paid to the Contractor.

Tenth: If at any time the President or the Contractor shall die or become incapacitated so as not to devote his personal attention to the work herein provided for, or if at any time the Company shall be of opinion that the work is not progressing satisfactorily, or is not being done as economically as, in the judgment of the Company, it should be done, the Company may upon fifteen days' written notice to the Contractor terminate this contract or any portion of same upon reimbursing the Contractor for all items of cost incurred by it to the date of termination plus ten per cent (10%), including compensation for the machinery purchased for said work, and the Company shall not be liable under any further liability to the Contractor in respect hereof.

Eleventh: The Company makes no agreement as to when the work of construction shall commence, nor that it will even commence, and the Contractor shall have no claim of any nature against the Company for delay in the commencement of said work of construction, nor if the Company should finally determine not to construct said Subway with its appurtenances.

Twelfth: The title to all materials purchased shall vest in the Company on delivery.

Thirteenth: Within thirty (30) days after the plans for the Subway have been approved by the authorities, as required by Chapter 520 of the Acts of 1906, the Engineer of the Company shall proceed to make an estimate of the cost of the construction of the Subway. The estimate is to include the actual work to be performed by the contractor, which it is understood is the construction of the Subway ready for its equipment. It is not to include any work to be performed under the direction of the Company by any of its departments, such as transportation of materials, furnishing power, relaying tracks, conduits, etc., or the work performed by the City or any other company in changing or re-laying sewers, water pipes, or other underground structures, or the cost of right of way or lands taken or any damages paid by the Company for occupation of lands, etc. The estimate is to be based on the current market prices for labor and material. It is to be completed within eighteen (18) months, if practicable, from the date that the Contractor commences work, and the Contractor is to be furnished with the full details of the estimate. If he is not satisfied with the same and shall so represent to the Company, a Commission of three (3) engineers—one appointed by the Company, one appointed by the Contractor, and, if necessary, a third appointed by the two first named—shall determine the proper estimate, which shall be binding upon both parties to this contract. This estimate may be changed from time to time by said Engineer of the Company or by said Commission, if an appeal is made to said commission, by adding thereto, if additional work not included in said estimate is awarded to said Contractor, or by deduction therefrom if work included in said estimate is withdrawn by the Company from said Contractor. The expense of said Commission to be divided equally between the Company and the Contractor.

If the aggregate actual cost of the work performed by the Contractor, including its compensation of ten per cent (10%), and the cost of liability insurance provided for by Section (c) of Paragraph Seventh, shall exceed the estimated cost, there shall be deducted from the ten per cent (10%) mentioned in Section Sixth, twenty-five per cent (25%) of the sum the actual cost exceeds the estimated cost. In case said twenty-five per cent (25%) exceeds the amount retained by the Company from the Contractor's compensation, then said Contractor shall pay to the Company any such excess at the completion of the work under this contract.

If the actual cost of the work performed by the Contractor is less than the estimated cost, the Contractor shall receive in addition to the ten per cent (10%) mentioned in section Sixth, twenty-five per cent (25%) of the amount that the actual cost is less than the estimated cost. Said twenty-five per cent (25%) shall be paid to the Contractor by the Company sixty (60) days after the completion of the contract.

IN WITNESS WHEREOF, the BOSTON ELEVATED RAILWAY COMPANY and the HUGH NAWN CONTRACTING COMPANY have caused their respective seals to be hereto affixed, and these presents to be executed in their names and behalf by their respective Presidents, thereunto duly authorized, the day and year first above written.

(SEAL) BOSTON ELEVATED RAILWAY COMPANY.

By (Signed) WILLIAM A. BANCROFT,

President.

HUGH NAWN CONTRACTING COMPANY,

By (Signed) HENRY P. NAWN, (SEAL)

President.

March 3, 1909.

In consideration of the execution of the within contract by the Boston Elevated Railway Company, I, HENRY P. NAWN, do hereby guarantee to the Boston Elevated Railway Company the due performance of said contract by the Hugh Nawn Contracting Company.

(Signed) HENRY P. NAWN.

KNOW ALL MEN BY THESE PRESENTS THAT we, HUGH NAWN CONTRACTING COMPANY, a Corporation organized under the laws of the Commonwealth of Massachusetts, and having its principal office in the City of Boston, as Principal, and the MASSACHUSETTS BONDING AND INSURANCE COMPANY, a Corporation created and existing under the laws of the Commonwealth of Massachusetts, and having its principal office in the City of Boston, in said Commonwealth, as Surety, are held and firmly bound unto the BOSTON ELEVATED RAILWAY COMPANY in the full and just sum of One Hundred Thousand ($100,000) Dollars, lawful money of the United States, to the payment of which sum, well and truly to be made the said principal binds itself, its successors and assigns, and the said Surety binds itself, its successors and assigns: jointly and severally, firmly by these presents.

SIGNED, SEALED AND DELIVERED this 31st day of March, A. D., 1909.

WHEREAS said Principal has under date of March 31st, 1909, entered into a certain written contract with the BOSTON ELEVATED RAILWAY COMPANY for the construction of the Main Street Subway, so called, in Cambridge, together with its appurtenances which the Boston Elevated Railway Company is authorized to construct under the provisions of Chapter 520 of the Acts of 1906.

NOW THEREFORE, the condition of the foregoing obligation is such that if the said Principal shall in accordance with the third paragraph of said contract well and truly hold the Boston Elevated Railway Company harmless and indemnified against any loss or damage to person or property occasioned by the negligence of itself, its sub-contractors or employees, which may not be covered by the insurance mentioned in the second paragraph of said contract, then this obligation shall be void: otherwise to remain in full force and effect in law.

IN TESTIMONY THEREOF, the said Principal has caused these presents to be sealed with its corporate seal, attested by the signature of its duly authorized officers and the said Surety has caused these presents to be sealed with its corporate seal, attested by the signature of its President and its Assistant Secretary the day and year first above written.

HUGH NAWN CONTRACTING COMPANY.
By (Signed) H. P. NAWN.

MASSACHUSETTS BONDING AND INSURANCE COMPANY.
By (Signed) F. J. FALVEY,
President.

(Signed) WM. H. DOWLING,
Assistant Secretary.

ELIOT SQUARE TERMINAL—COST

Report to Chief Engineer, Boston Transit Commission, page 50.
Auditor's Statement, Boston El. Ry. Co., page 51, table A-8.
Contract and Bond, Eliot Square Terminal, pages 52 and 53, tables H-11 and H-12.

BOSTON TRANSIT COMMISSION

15 Beacon Street

Mr. E. S. Davis, January 10, 1917.
Chief Engineer.

Dear Sir:–

In compliance with your request for a report of the Cost of the Eliot Square Terminal, to be used in connection with my report of January 6, 1917, on the Cost of the Cambridge Main Street Subway, I herewith submit the following:

The statement from the Auditor's Department, Boston Elevated Railway Company (marked A-8) was obtained by me when making my report on the Cambridge Main Street Subway, and is appended hereto.

For the purpose of separating the payments and getting them more in detail, I have gone over the accounts with Mr. H. E. Whiting in the manner mentioned in my previous report. Record plans and a copy of the contract under which a considerable portion of the work was performed have been obtained and are also appended.

COST

The cost shown is to November 1, 1916, and was kept in accordance with the provisions of the Act under which the subway work was performed and therefore includes equipment with the construction work.

E. S. D. 1-10-1917.

Construction by Contractor, incl. $150,213 for material from Cambridge Subway	$641,449.56
*Other construction	25,658.37
Motor pumps and switches	1,169.22
Concrete fence	11,254.65
Heating system	3,531.37
Work by Depts. of Boston El. Ry. Co.	36,574.66
	$719,637.83
Miscellaneous Credits	4,724.15
	$714,913.68 (See table A-8)

*Other work includes sidewalks, foot bridge, drainage system, locker room, etc.

The items of Engineering, Land, Taxes, Interest, etc., are shown in table A-8, and bring the total cost up to $998,587.05, although a further adjustment is to be made as noted in table A-8.

There is considerable data in calculation books, estimates, etc., on hand at the Boston Elevated Railway Company's offices, from which separate estimates of the cost of yard, buildings, station platform and equipment, can be made should it be considered desirable.

Respectfully submitted,

(Signed) E. R. SPRINGER,
Assistant Engineer.

In connection with the Cambridge, Main St. Subway, there are also the Eliot Square Terminal and the Bennett St. Car House.

The Eliot Square Terminal occupies the whole area bounded by Murray, Boylston and Eliot Streets and Charles River Road.

Part of this area was originally occupied by the Boylston St. Car House of the West End St. Ry. Co., the remainder having been purchased for the Terminal. Blue prints of the land takings accompany this statement, and also Blue Print showing relative location of Eliot Square and Bennett St. and heating system.

No adjustment has been made with the West End St. Ry. Co. for reimbursement for this land and car house.

The cost of the Eliot Square Terminal (exclusive of tracks) is as follows:

Engineering	$3,495.69	
Right of Way	222,711.04	
Shops and Car Houses	714,913.68	
Stadium Station	3,814.90	
Interest during Construction	43,566.64	
Taxes during Construction	10,135.10	
Total June 30, 1916	$998,637.05	
Less amt. erroneously charged	50.00	
Total November 1, 1916		$998,587.05

Note: This cost includes the heating plant which supplies heat to the Eliot Square Buildings, and also to the Bennett St. Car House and the Division 7 Headquarters Building.

The heating system cost, exclusive of equipment located in the Harvard Power Station	$25,333.46
and it is estimated that only one half of this should be applied to the Eliot Square Shops, or	12,666.73
The tunnel through which the heating system runs to the buildings cost $28,356.69 of which is included in above cost of the Eliot Sq. Shops.	28,141.28
There should be applied to the cost of the Eliot Sq. Shops only (the balance belonging to the Bennett St. Car House)	18,900.13
Amount to be deducted from cost of Eliot Sq.	$21,907.88

When the adjustment is made with the West End St. Ry. Co. for the old Boylston & Murray St. Car Houses and the new Bennett St. Car House there will be a further charge to the Eliot Sq. Car House.

See later Statement of November 1, 1918.

CONTRACT AND BOND FOR CONSTRUCTION (H–11)
ELIOT SQUARE TERMINAL

This AGREEMENT made this 7th day of September, 1910, between the BOSTON ELEVATED RAILWAY COMPANY (hereinafter called the "Company") and the HUGH NAWN CONTRACTING COMPANY (hereinafter called the "Contractor").

WITNESSETH

WHEREAS under date of March 31, 1909, the parties entered into a Contract for the construction by the Contractor of the Main Street Subway, so-called, together with its appurtenances, and it was understood by the parties that the word "appurtenances" included terminals; and,

WHEREAS it now appears that owing to the language of Section 1 of Chapter 520 of the Acts of 1906 a doubt has arisen as to whether terminals are included in appurtenances.

NOW, THEREFORE, in order to carry out the original intention of the parties, it is agreed between them as follows:

First: That subject to the provisions of the following section the contract of March 31, 1909, shall include the construction of the so-called Boylston Street Terminal, and the contract shall be construed as if the same had been originally included therein.

Second: The Company may from time to time withdraw from the Contractor such portion of the work of constructing the Boylston Street terminal as it may elect, and may itself perform such work of construction or cause it to be done by others than the Contractor, without any responsibility in respect thereof to the Contractor.

IN WITNESS WHEREOF the BOSTON ELEVATED RAILWAY COMPANY and the HUGH NAWN CONTRACTING COMPANY have caused their respective seals to be hereto affixed, and these presents to be executed in their names and behalf by their respective Presidents thereunto duly authorized on the day and year first above written.

BOSTON ELEVATED RAILWAY COMPANY,
By (Signed) WILLIAM A. BANCROFT, *President.*

HUGH NAWN CONTRACTING COMPANY,
By (Signed) H. P. NAWN, *President.*

In consideration of the execution of the within contract by the BOSTON ELEVATED RAILWAY COMPANY, I, Henry P. Nawn, do hereby guarantee to the Boston Elevated Railway Company the due performance of said contract by the Hugh Nawn Contracting Company, and do hereby assent to the same and agree that my guaranty of the contract of March 31, 1909, shall remain in full force and effect and apply to the same as modified by the within contract.

(Signed) H. P. NAWN.

THE MASSACHUSETTS BONDING AND INSURANCE COMPANY as surety on the bond given by HUGH NAWN CONTRACTING COMPANY to the Boston Elevated Railway Company under date of March 31, 1909, hereby consents to the within agreement, and agrees that its liability on said bond shall remain in full force and effect notwithstanding any such modification of the agreement of March 31, 1909, as may be affected by the within contract.

MASSACHUSETTS BONDING AND INSURANCE COMPANY
(Signed) T. J. FALVEY, *President*
R. C. DENORMANDIE, *Assistant Secretary.*

BOSTON TRANSIT COMMISSION

15 Beacon Street

Mr. Edmund S. Davis, Chief Engineer. Boston, January 12, 1917.

Dear Sir:—

In compliance with your request for a report on the Costs to the Boston Elevated Railway Company of the Beacon Hill Tunnel Approach (Cambridge Connection) and the Cambridge Bridge, I am submitting herewith copies of the Statement from the Auditor's Department, Boston Elevated Railway Company, which have been marked A-9 to A-12, in order to follow consecutively those copies attached to my reports on the Cambridge Main Street Subway and the Eliot Square Terminal, of January 6th and 10th, respectively.

The cost of the Beacon Hill Tunnel Approach (Cambridge Connection) is given as $397,343.45, and the Boston Elevated Railway Company's share in the cost of the Cambridge Bridge is given as $591,747.27. (See table A-9).

The tables marked A-10, A-11 and A-12 show interest tables and other information submitted by the Auditor's Department.

Respectfully submitted,

(Signed) E. R. SPRINGER,
Assistant Engineer.

(A–9)

The Company's share of the cost of the new Cambridge Bridge is (exclusive of track) Nov. 1, 1916		$591,747.27
The Cambridge Connection (approach to the Beacon Hill Tunnel) was reported as costing approximately (exclusive of track) June 30, 1916, $412,000.00		
The actual cost November 1, 1916, is as follows (exclusive of equipment and all work done inside the Beacon Hill Tunnel)		397,343.45
Engineering	$10,239.45	
Right of Way	256,600.99	
Other Land	16,983.04	
Structure and Foundations	102,924.23	
Crossings, etc.	555.94	
Interest during Construction	9,010.55	
Taxes during Construction	1,029.25	
There are some further land damages still to be adjusted.		
The work in the tunnel amounting to $39,693.89.		
The cost of the whole Cambridge Subway System, exclusive of track and rolling stock would be:		
Subway proper (exclusive of equipment)		7,073,349.98
Eliot Square Terminal		998,587.05
Cambridge Bridge		591,747.27
Cambridge Connection		397,343.45
		$9,061,027.75

This cost does not include the City of Boston Investment in the Beacon Hill Tunnel of $1,457,382.04. (See later Statement Nov. 1, 1918).

TABLE OF INTEREST CHARGES BY MONTH.

	Cambridge Subway Construction			Cambridge Subway Equipment			Beacon Hill Tunnel Approach			Eliot Square Terminal and Camb. Sub. Misc.		
	Amount Expended Figured daily	Rate	Interest	Amount Expended	Rate	Interest	Amount Expended	Rate	Interest	Amount Expended (6 mos. Int. fig. on Ave. per mo.)	Rate	Interest
Bal. from June 30, 1910		3¼%	$55,228.83							$206,278.09	6	$6,188.34
December, 1910		3¼%	52,343.81							286,652.61		
January, 1911		3¼%	21,071.82							328,704.99	6	1,643.52
February, "		3¼%	13,983.26							394,694.54	6	1,973.47
March, "		3¼%	13,269.39							409,108.00	6	2,045.54
April, "		3¼%	14,861.61				15 mos. Int. fig. on Ave. per. mo. $26,786.84 97,528.76	6	$2,008.95	343,091.19	6	1,715.46
May, "		3¼%	14,509.64							360,312.20	6	1,801.56
June, "		3¼%	15,298.48							408,270.30	6	2,041.35
July, "		3¼%	15,067.82							561,059.34	6	2,805.29
August, "		3¼%	15,797.88							673,442.46	6	3,367.21
September, "		3¼%	16,101.68							631,787.72	6	3,158.94
October, "		3¼%	15,871.31				134,135.57	6	670.68	774,030.04	6	3,870.15
November, "		3¼%	16,749.89				155,449.18	6	777.25	937,161.65	6	4,685.81
December, "		3¼%	16,601.00				202,645.05	6	1,013.22	984,818.41	6	4,924.09
				(From El. Sq.)		$11,165.28						*11,165.28*
January, 1912		3¼%	17,587.32	342,173.50	6	1,710.86	221,265.43	6	1,106.33	751,282.71	6	3,756.41
February, "		3¼%	17,877.44	359,883.29	6	1,799.42	239,666.45	6	1,198.33	775,320.72	6	3,876.60
March, "		3¼%	16,950.58	382,513.10	6	1,912.56	252,798.98	6	1,263.99	790,377.43	6	3,951.89
April, " (22 days)		3¼%	12,989.81	397,837.78	6	1,458.74	265,035.34	6	971.80	798,079.34	6	2,926.29
			$362,161.57			$18,046.86			$9,010.55			$43,566.64

(A–10)

(A–11)

TABLE OF INTEREST AND TAXES—CAMBRIDGE SUBWAY SYSTEM

AMOUNT CHARGED

Cambridge Subway—Construction	3¼%	$362,161.57	$9,125.34
" " Equipment . .	6%	18,046.86	. . . . .
Cambridge Bridge		. . . . .	. . . . .
Beacon Hill Tunnel App. and Equip. in Tunnel	6%	9,010.55	1,029.25
The cost of track and equipment amounted to 33.805% of total cost of Construction at date of opening for use. The Interest item is shown here divided on that basis.			
Construction $5,964.53			
Equipment . . 3,046.02			
Eliot Square Terminal	6%	43,566.64	10,135.10
The cost of tracks and equipment amounted to 4.845% of total cost of Construction at date of opening for use. The Interest item is shown here divided on that basis.			
Construction $41,455.86			
Equipment . . 2,110.78			
TOTAL		$432,785.62	$20,289.69

(A–12)

Interest figured on basis of return on capital paid in and Taxes on Capital Stock, as prescribed by the Interstate Commerce Commission

	Interest	Taxes
Cambridge Subway Construction	$648,672.97	$234,974.57
Cambridge Subway Equipment	7,409.57	1,540.35
Cambridge Bridge	54,660.93	12,038.07
Beacon Hill Tunnel Approach and Equipment in Tunnel	7,289.60	1,535.85
The cost of tracks and equipment amounted to 33.805% of total cost of construction at date of opening for use. The Interest and Tax item is shown here divided on that Basis.		
Interest Taxes		
Construction .. $4,847.35 $1,015.66		
Equipment ... 2,442.25 519.19		
Eliot Square Terminal	37,289.55	8,044.87
The cost of tracks and equipment amounted to 4.845% of total cost of Construction at date of opening for use.		
The interest and Tax item is shown here divided on that Basis.		
Interest Taxes		
Construction .. $35,482.87 $7,655.10		
Equipment ... 1,806.68 369.77		
Total Interest and Taxes that might have been charged	$755,322.62	$258,133.71
Amount that was actually charged as per detail on previous page	432,785.62	20,289.69
Additional amount that might have been charged	$322,537.00	$237,344.02

BOSTON PUBLIC LIBRARY
3 9999 05133 763 0

DEC 29 1952